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Outline of 10-Year and 'Eighth 5-Year' S&T Development Plan

92FE0654A Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 19 May 92 p 2

[Article: "People's Republic of China Science and Technology Development 10-Year Program and Eighth 5-Year Plan Outline—Key S&T Tasks for 1991-2000"]

[Text] Editor: The People's Republic of China Science and Technology Development 10-Year Program and Eighth 5-Year Plan Outline (1991-2000) is composed of five parts. Because of space restrictions, however, ZHONGGUO KEXUE BAO is only able to published the second part—key S&T tasks for 1991 to 2000.

The S&T tasks for the 1990's are: 1) Orient toward the main battlefields of economic construction and use S&T, especially electronic information and automation technology, to upgrade traditional industry, modernize production technology and equipment in traditional industry, make administration and management more scientific, and establish an energy-saving, consumption- reducing, water-saving, and land-conserving and resource conserving-type economy; 2) Focus on developing high technology and achieve its industrialization; 3) Make major breakthroughs in certain important realms of readjusting the relationship between man and the environment, especially in S&T for population control, environmental protection, rational resource and energy resource development and utilization, and other areas; 4) Make significant progress in basic research. While making arrangements for these tasks, we must also be extremely concerned about extending and applying S&T achievements and converting the potential wealth they create to material wealth. We must make major efforts to develop electronic technology to derive enormous economic benefits and make it a pillar of our national economy.

I. Agricultural and Rural S&T

Agriculture is the foundation of our national economy. Sustained growth in agricultural production is a decisive factor in stable development of our national economy. It concerns the rise or decline of the cause of socialist construction in China. China's large population pressure and relative inadequacy of resources, especially our shortages of cultivable land and water resources, determine that China's agricultural development must unwaveringly take the route of using S&T to invigorate agriculture.

Our agricultural S&T development objectives for the next 10 years:

1. Make major efforts to develop and extend S&T achievements and advanced and appropriate production technology, increase the contribution of S&T progress to agricultural growth from 35 percent to 50 percent during this century.

2. Attain advanced world levels of the early 1980's in S&T levels in agriculture, forestry, animal husbandry, fishery, and other important agricultural realms. Continue to maintain a vanguard status in the world in soil improvement, breeding crops with multiple resistance, utilizing the advantages of hybrids, and other advantageous realms.

3. Make comprehensive improvements in technical levels and management levels in township and town enterprises and state farms, increase the contribution of S&T progress factors to increases in gross value of output in township and town enterprises and state farms to 40 to 50 percent.

4. Form a relatively complete agricultural S&T research and development organizational structure and work system, basically establish a rural S&T service system adapted to the development needs of our rural commodity economy.

The primary tasks are:

1. Reinforcing development and extension of S&T achievements is the primary task in agricultural S&T work for the next 10 years, especially during the Eighth 5-Year Plan. The state will use implementation of the "Spark Plan", "Bumper Harvest Plan", "Setting the Prairie Ablaze Plan", Achievements Extension Plan, and various types of development and extension activities to achieve an extension rate of more than 60 percent for agricultural (including forestry and animal husbandry) S&T achievements.

2. Focus on solving major S&T questions to promote agricultural development.

Agricultural, forestry, livestock and poultry, and aquatic improved variety breeding: cultivate about 250 new crop varieties during the Eighth 5-Year Plan, increase yields more than 10 percent, renew primary crop varieties one time; do selective breeding of 120 new improved forest strains, increase the timber volume by 10 to 20 percent; attain a popularization rate of about 30 percent for improved livestock, poultry, and aquatic product varieties. The focus in crop breeding is on improving yields and resistance, cheapness and product quality, and developing grains, cotton, and oil crops.

Comprehensive development and improvement of agricultural regions: during the Eighth 5-Year Plan, focus on five moderate and low-yield regions: the Huang He, Huai He, and Hai He, the Song Jiang, Nen Jiang, and San Jiang plain, the arid lands of northern China, the loess plateau, and the red soil and yellow soil of southern China in establishing 50 different types of agricultural comprehensive development and improvement demonstration zones, provide cultivation and raising technologies for crop, forest, livestock and poultry, aquaculture, and other intensive production, and provide S&T guarantees for bumper harvests on about 800 million mu of moderate and low-yield fields in these five regions.

Rational development, utilization, and protection of agricultural natural resources: During the next 10 years we must adhere to rational development and utilization of agricultural natural resources, control destruction of agricultural natural resources and the agricultural ecology and environment, solidly reinforce monitoring and assessment of cultivated land, pastures, mountain forests, beaches,

and water areas, and propose optimal programs for rational development and comprehensive utilization.

Agricultural engineering technology and farm product storage, transportation, processing, and comprehensive utilization: Develop institutional agricultural technology; do research and development on the mechanization technology and equipment needed for appropriate scales for management of cropping, breeding, and farm product storage, transportation, and processing; study comprehensive utilization technology for crop straw, cakes, dregs, and liquid wastes.

3. Promote S&T progress in township and town enterprises and state farms. To guide township and town enterprises in relying on S&T progress and taking the route of intensive development, during the Eighth 5-Year Plan we should establish 300 pillar industries and 100 regional development zones, provide 100 sets of advanced and appropriate technical equipment, train 2 million rural S&T skilled personnel of all categories, and make the primary industries of township and town enterprises such as the construction materials industry, farm and sideline product processing industry, textile and clothing industry, light industry, feed industry, and so on develop in the direction of forming groups, specialization, and monitoring. Select several state farms and collective farms for developing model demonstrations of intensification, scale production, and industrialization of agriculture.

II. Energy Resources

Energy resources are the key factor in promoting development of our national economy. China's energy resource S&T should provide technical support for energy resource development and conservation.

The goals of energy resource S&T development for the next 10 years:

1. About 50 percent of the primary technical equipment in the energy resource industry should attain international levels of the 1980's, and equipment sets used in large numbers and over broad areas should be basically established on domestic sources; the proportion of energy-saving equipment in primary energy consuming industries should reach 20 percent.

The tasks for the Eighth 5-Year Plan are:

1. Resolve technical problems with coal seam extraction in large open-cut coal mines and in hard-to-mine coal seams and deep coal seams. The focus is on complete sets of equipment for fully mechanized tunneling and support. Work on fully mechanized technical equipment at the 10,000 tons/day level. Provide technical guarantees for controlling horrible accidents in mines.

2. To exploit the resource potential of old oilfield resources in eastern China, develop low permeability oil pools and oil and gas reserves in oil fields with complex fault blocks, perfect dense oil steam pumping and steam oil expulsion technology, accelerate industrialization experiments for polymer expulsion, focus on breakthroughs in new tertiary oil extraction and horizontal drilling technology. Provide important technologies for oil and gas exploration, development, and collection and transmission in deserts, on beaches, and in the seas.

3. Coordinate with development of the hydropower resources of the upper reaches of the Huang He, the trunk and tributaries of the upper and middle reaches of the Chang Jiang, and the Hongshui He basin, provide advanced technology for tall dam hydropower station construction and ship passage. Develop large capacity, high-parameter power generation and long-distance power transmission technology.

4. Focus on construction equipment and advanced nuclear fuel processing technology centered on 600MW pressurized-water reactor nuclear power plants. Complete development of the 200MW nuclear low-temperature heat supply reactor project.

5. Focus on different uses, develop various types of coal combustion and gasification technology, develop circulating fluidized beds, pressurized fluidized beds, coal gasification combined cycle power generation technology, and so on.

6. Develop high-power wind-powered generators, high-efficiency and low-cost solar power, hydrogen energy, and other non-mineral energy resources.

III. Communication

Communication and transportation are the aortas of our national economy and essential guarantees for promoting economic and social development and improvement of the people's living standards.

During the next 10 years, the goals and tasks for communication and transportation technology development are:

Provide S&T guarantees for a substantial increase in transportation capacity and improvement of transportation efficiency and results, for gradually shifting China's communication and transportation onto the track of being based on modern basic facilities, technical equipment, and management measures, and for establishing a comprehensive transportation system.

1. For railroads, adopt advanced and appropriate technology to accelerate construction of new lines and upgrading of old lines, gradually achieve electrification and a shift to internal combustion for traction motive power, modernization of administration and management, and automation of transportation control. Further perfect and extend heavy load transportation technology, develop a second generation of heavy load unit trains, magnetic levitation trains, and new types of locomotives, develop sets of equipment for high-speed railways. During the Eighth 5-Year Plan, raise the unit train and transportation capacity on the Da-Qin [Datong-Qinhuangdao] line to the 10,000 ton grade, place the 160 kilometer/hour standard high-speed passenger railroad into operation, and focus on developing 200 kilometers/hour and above high- speed dedicated passenger line technology.

2. For highways, gradually establish a national highway trunkline system composed of high-grade roadways to

achieve a shift to high speeds and high efficiency for vehicle transportation and a shift to large sizes for truck shipping, and make a major effort to develop and achieve modernization of design, construction, maintenance, management, and transportation services. During the Eighth 5-Year Plan, while further perfecting sets of construction technology for asphalt high-grade roadways, focus on research on cement and concrete surface construction technology, develop road construction (maintenance) machinery, inspection equipment, safety control systems, and new types of highway passenger automobiles and special-purpose trailers.

3. For water-borne transportation, complete an oceangoing flotilla equipped with modern technology, form a high efficiency north-south transportation passageway with large tonnage vessels as the main force, and make a major effort to develop trunkline shipping on the Chang Jiang, Zhu Jiang, and Heilong Jiang water systems. Develop and extend grouped centralized loading containers and staple decentralized freight and decentralized loading and transportation, mixed passenger and freight loading transportation, and interior river segmented barge pushing transportation. During the Eighth 5-Year Plan, focus on research and development regarding river mouth and shipping channel improvement technology and all types of key dredging equipment, develop interior river rapid and high-speed passenger boats, large shallow-draft boats and various types of self-unloading boats, develop high efficiency, low energy consumption harbor loading and unloading equipment and ship communication control systems.

4. For civil aviation, focus on breakthroughs on trunkline aircraft and helicopter design and manufacturing technology and basically have the capability of designing and manufacturing 150 to 200 seat trunkline aircraft and light helicopters by the end of this century. Further develop and perfect flight safety assurance technology and operational management technology.

5. For pipeline transmission, comprehensively focus on pipeline transmission technology and construction technology for terrible and unique conditions and all types of oil products, achieve sealed transmission and optimized operation, and complete a pipeline system with a substantial yearly coal transmission capacity. During the Eighth 5-Year Plan, focus on research on long-distance, large-diameter pipeline transmission technology and equipment for desert oil fields in Xinjiang.

IV. Raw Materials

Raw materials are the foundation of our national economic development.

The goals for raw materials S&T development during the next 10 years are:

1. Develop product varieties, improve quality. Readjust the product variety mix, make product variety and quality for raw materials attain levels of the developed nations in the early 1980's to meet the development needs of all sectors of our national economy.

2. Reinforce digestion, absorption, development, and innovation work for imported technology, increase levels of domestic production for production equipment, make production technology and equipment sets in large raw materials enterprises attain levels of the developed nations in the 1980's.

3. Use microelectronics technology to upgrade traditional production technology for raw materials. Over the next 10 years, popularize electronics technology in the areas of product design, automated production control, and administrative management in large and medium-sized enterprises in the iron and steel, nonferrous metals, chemical, petrochemical, and construction materials industries.

4. Do research on resource comprehensive utilization technology and develop energy conservation and consumption reduction technology, provide technical support for upgrading traditional techniques and technology in the raw materials industry.

The tasks during the Eighth 5-Year Plan are:

1. In the iron and steel industry, focus on resolving S&T problems in ore excavation, smelting, rolling, and so on, make breakthroughs in new mine extraction technology, oxygen and coal reinforced iron smelting in blast furnaces, DC and plasma steel smelting, and medium-width thin plate blank continuous casting and continuous rolling technology to enable steel product varieties and quality to meet the development needs of the energy resource, communication, machinery, electronics, light, textile, and other industries.

2. For nonferrous metals, develop comprehensive energy conservation technology focused on aluminum and polymetallic paragenetic mineral comprehensive utilization technology, provide technical support for developing lead, zinc, and copper, do research on optimized resource intensive processing technology for tungsten and other metals.

3. In the chemical industry, place the development of advanced large-scale production technology in the primary position, focus on a shift to domestic production of large-scale production technology for the petrochemical industry, chemical fertilizers, plastics, agricultural film, and so on, accelerate the pace of formulation of farm chemicals, dyes, and other chemical industry products, make a major effort to develop high-grade, precision, and fine products, make about 70 percent of our chemical industry products attain international standards and advanced standards in foreign countries.

4. For construction materials, focus on R&D and major efforts to extend energy conservation and surplus heat utilization technology, substantially reduce energy consumption in the production of construction materials. Do research on intensive processing technology for nonmetallic materials.

V. Machinery

The machinery industry is the outfitting department for the national economy and an important standard for evaluating a nation's S&T levels and economic strengths.

The S&T development goals for the machinery industry during the next 10 years and the tasks for the Eighth 5-Year Plan are:

1. Focus on important sets of technical equipment to develop agriculture, energy resources, communication, raw materials, and other realms, accelerate digestion and absorption of imported technology and equipment, and improve our own development. design, and manufacturing capabilities to achieve commercialized production of sets of equipment for large-scale hydropower, thermal power, power transmission and transformation, communication, metallurgy, mining, the chemical industry, and so on so that their overall technical levels attain levels in foreign countries of the late 1980's. The focus during the Eighth 5-Year Plan is on digesting and developing 300MW and 600MW sub-critical thermal power generators, 600MW nuclear power equipment sets, 500 kV AC and DC power transmission and transformation equipment, large- scale continuous casting and continuous rolling and large-scale mining equipment, large-scale sets of chemical fertilizer equipment, 300,000 tons/year ethylene equipment, and so on.

2. Do R&D on basic machinery and related basic components. During the Eighth 5-Year Plan, focus on dealing with key design and manufacturing technology for basic machinery and basic components, improve product quality and technical levels, meet the development needs of the machinery and equipment industry.

3. Develop electromechanical integration and advanced design and manufacturing technology and testing and sensing technology. During the Eighth 5-Year Plan, make breakthroughs in key general technology for the machine-building and electronics industry, develop and extend computer-aided design (CAD) technology, develop electronic information technology and numerical control machine tools, digital displays, automatic instruments, and so on integrated with precision machinery, make a substantial improvement in the technical levels and quality of machinery products, and attain advanced world levels of the early 1990's for 30 to 40 percent of our primary machine-building and electronics products; electromechanically integrated products should account for about 15 percent of the total number of electromechanical products; enterprises that have adopted CAM technology should account for 5 to 10 percent of the total number of large and medium-sized enterprises.

4. Improve design and manufacturing levels in the automobile and shipbuilding industry. By the end of the Eighth 5-Year Plan, parts and components used in the automotive industry should basically be based on domestic sources and the performance of primary civilian ships and offshore petroleum platforms related to energy resources, transportation, and so on should attain international levels of the same period.

VI. Light Industry and Textiles

The light and textile industries are an important part of our national economy and an important source for the state to accumulate capital and earn foreign exchange.

The goals for S&T development in the light and textile industries during the next 10 years are:

Strengthen R&D on new technologies, new techniques, and new products, increase the added value of products; strengthen technical upgrading and reduce energy consumption and materials consumption in medium-sized and small enterprises. By the year 2000, technical equipment levels in key sectors of the light and textile industries should attain the levels of developed nations in the 1980's and try to approximate or attain levels of the early 1990's in some primary equipment; R&D on new products and new product varieties should increase from the present 100,000 types to 300,000 types and the product quality of about 40 percent should attain levels in foreign countries of the late 1980's or early 1990's. S&T progress factors as a proportion of the gross value of output in the textile and light industries should be increased to 40 to 50 percent.

The primary tasks for light and textile industry S&T during the Eighth 5-Year Plan are:

1. Improve overall levels for light industry products, deal with light industry product pattern design and manufacture, exterior decoration, packaging, and other general technologies.

2. Do R&D on new technologies and new equipment for salt-making, papermaking, ceramics, and other production.

3. Develop large-scale production technology for chemical fiber raw materials; improve post-dyeing straightening and surface precision processing technology for fabrics and cotton spinning equipment levels.

4. Do research on and extend applications of electronics technology in light and textile industry design, processing, inspection and other production processes.

VII. High Technology Research and Its Industrialization

High technology and its industrialization will become a pillar force in international competition during the 21st Century. China must develop its own high S&T and its industry, greatly increase labor productivity, and gain a leading status in the world high S&T realm.

During the next 10 years, the development goals for high-tech and its industry in China are:

Track international high-tech developments in certain realms where we hold an advantage, make breakthroughs with new technologies, strengthen applied research and engineering development, extend high-tech achievements, and form high-tech industries. High-tech research and industrialization will be included in the state's "863" High-Tech Research Plan, Plan To Attack Key Problems, and "Torch" Plan. Focus on developing electronic information, computers and software, communications, bioengineering, automation, new generation energy resources, new materials, superconductors, lasers, and other high technologies.

1. Biotechnology should make new breakthroughs at the levels of high-tech tracking, applied research, and establishing high-tech industry. During the Eighth 5-Year Plan, it should provide technical support for new developments in agriculture, medicine, light industry, and other traditional industries. Continue to study and extend over a large area the two-strain method hybrid paddy rice and increase yields by 10 to 15 percent; do research on new resistant strains of rice, wheat, and other primary grain crops and, while ensuring increased grain yields, substantially reduce the amounts of farm chemicals used; develop plant genetic atlas research, try to make major research achievements; track international levels for protein engineering in protein structure determination, molecular design, directional improvement, and other areas; complete 1 to 2 types of genetic engineering vaccines and new medicines and form an export capability; promote 12 to 13 types of high-tech products with major economic benefits and social benefits and place them on the market, gradually form a biotechnology industry.

2. Microelectronics technology should focus on silicon technology. During the Eighth 5-Year Plan, integrated circuit technology should develop from the present 3 μm to 0.5 μm and production technology should developed from the present 5 μm to 0.8 μm. Strengthen research on gallium arsenide large- scale integrated circuits [LSIC], gain an understanding of production technology for medium and small-scale gallium arsenide integrated circuits. By the year 2000, achieve 60 percent domestic production for LSIC needed on the domestic market and focus on R&D on special-purpose equipment, testing instruments, and special-purpose materials to complete a microelectronics industry based on China that has a self-development capability.

3. For photoelectronic technology, develop new electronic components and systems integration technology for use in sensing, computing, communications, and other areas. The focus is on developing high-speed fiber optic communications and optical computing system goal products, development of key parts and components, and breakthroughs with element technology.

4. Technology with space applications is focused on research on satellite ground observations, monitoring objectives from space, development of information collection, and real-time signal processing technology and integration with development of space microgravity applications to conduct research on space materials and the life sciences. During the Eighth 5-Year Plan, the focus is on satellite-carried synthetic aperture radar, imaging spectrographs, and other new remote sensing transducers, and technical breakthroughs for remote sensing dynamic imaging information satellite-ground real-time transmission and processing technology, and global space positioning system applications.

5. The key tasks for computer technology are to complete construction of China's computer industry and increase the value of output in the computer industry to 3 to 4 percent of our GNP and increase the market position of Chinese-made computers from the present 60 percent to 80 percent. During the Eighth 5-Year Plan, focus on breakthroughs with high-grade microcomputer production technology and workstation systems, 32-bit ultraminiature computer system technology, large-scale computer systems (fourth generation), and key peripheral technology, and to develop a group of computer systems with elementary intelligent behavior and oriented toward intelligent applications.

6. The focus for software technology is on intelligent software development methods and tools, establishing a software engineering development environment, breakthroughs in software product production automation technology, extending our own copyrighted software product series, and gradually forming a software industry.

7. The development direction for communications technology is toward digitization by using advanced communications technology to upgrade existing communications networks and tracking the development of world communications technology. During the Eighth 5-Year Plan, the focus is on research on DS 5 optical communications systems, establishing a DS 5 optical communications system experiment stage, and research on 900 MHz digital mobile communications systems. Make breakthroughs in broadband integrated digital network asynchronous transmission mode (ATM) technology, satellite communications, digital microwave, group exchange, complete optical coherent fiber optic communications technology, high compression rate signal source processing technology, and other areas.

8. For automation technology, use applications as a guide to undertake work at the four levels of tracking research, attacking key technical problems, developing goal products, and applications engineering. During the Eighth 5-Year Plan, complete construction of a CIMS experimental research center and seven element laboratories, complete design and construction tasks for four CIMS applications plants, and attack key problems related to several key technologies and phase objective products; complete a robot assembly demonstration and experiment line, develop five types of robot products: robots for use in remote control mobile operations in the nuclear industry, wall climbing inspection robots, robots that operate in terrible environments, underwater cable-less robots, and precision assembly robots.

9. New materials technology should focus on applied research and industrialization, undertake tracking and innovation for a new generation of materials, study and develop several key materials for national defense construction, high-tech development, and technical upgrading in traditional industry, and form a new materials industry. By the year 2000, try to increase the value of output in the new materials industry to 30 billion yuan. During the Eighth 5-Year Plan, the development focus in the new materials field should be on electronic information materials, high-performance composites, new metallic materials, new polymer materials, superconducting materials, new ceramic materials, and organic function materials, and establishing about 20 new materials project technology development and experiment base areas.

10. For superconducting technology, the focus is on research on applied fabrication technology for high-temperature superconducting materials and on high-temperature superconducting film and high-temperature superconducting components in an effort to make substantive breakthroughs. At the same time, we will be doing applied research on low-temperature superconductivity.

11. The focus for laser technology is on developing laser processing and laser inspection, research on new types of high-power laser components, developing laser flexible processing systems, and developing laser medical and laser therapy equipment to form a laser new-tech industry.

VIII. High and New Technology Industry Development Zones

Establishing high and new-tech industry development zones is an important strategic deployment for China's development of high and new-tech industry. It has major significance for rapid conversion of high-tech achievements into direct forces of production, accelerating the formation of high-tech industry in China, accelerating upgrading of traditional industry, improving the status and competitiveness of Chinese commodities in the world market, and promoting the future development of China's economy, society, and S&T.

The objectives and primary tasks for high and new-tech development zones during the next 10 years are:

1. Achieve the commercialization, industrialization, and internationalization of high-S&T achievements. Implement several "Torch" Plan projects, form scales for 70 percent of them and export 30 percent of them to earn foreign exchange. Establish several large modernized enterprises and enterprise groups with values of output of several 100 million yuan and participate in international competition.

2. Development zones should become high-tech industry base areas, radiation sources for using high-tech to upgrade traditional industry, experimental regions for intensifying reform of the S&T system, and windows open to the outside world.

3. Support and encourage S&T personnel in scientific research organizations, institutions of higher education, and small and medium-sized enterprises to enter development zones and establish various types of high and new-tech enterprises with the system of collective ownership as the primary factor. At the same time, create several S&T entrepreneurs who are familiar with specialized technology and understand management and administration.

4. The key development realms for high-tech industry should be electronic information, bioengineering, new materials, aerospace, new energy resources, high efficiency, and energy conservation, the ecology and environment, marine engineering, laser technology, biomedical engineering, radiation technology, and other fields, with selective development in each of the development zones.

5. Develop high-tech industry, implement administrative mechanisms for independent administration, responsibility for profits and losses, self- development, and self-restraint.

IX. Enterprise Technology Development

Enterprises are the main factor in our national economy and the integrators of S&T with the economy. Enterprise technology development and S&T achievements applications are the source of enterprise progress.

The tasks for enterprise technology development during the next 10 years are:

1. Develop basic products and advanced production technology for them. Focus on machinery basic components, electronic parts and components, patterns, and related raw materials, etc., promote improvement of the technical performance of finished industrial products and renewal and replacement of products.

2. Develop product design technology. Focus on developing design technology for advanced products, gain a grasp of computer-aided design, strive to integrate with computer-aided manufacturing, improve China's industrial product design and development capabilities.

3. Develop key production technologies and inspection technologies. Focus on energy conservation, reducing consumption, and improving product quality, develop new techniques, new technologies, and new equipment. Use electronics technology to improve automated control levels in production and improve modern administration and management results and overall quality in enterprises. During the Eighth 5-Year Plan, select 251 key large and medium-sized enterprises in industry and communications to carry out technical upgrading based on the direction of readjustment in the product mix and industrial structure and enterprise S&T progress, make their products attain advanced levels in foreign countries and use them to squeeze into the international ranks and become the main force in competition with their international counterparts. Develop 17 categories of superior quality products with broad-ranging applications, advanced technical performance, good competitive capabilities, and international brand-name reputations, make a significant change in the face of China's industrial production. Select 20 key technologies with advanced, appropriate, general purpose, and other characteristics, extend them during technical upgrading in enterprises to raise equipment and materials in traditional industry up to a new level.

X. Social Development

Rapid population growth, relative shortages of resources, and increasing degradation of our ecology and environment have now become enormous pressures on China's social and economic development.

The S&T goals for social development in China during the next 10 years are:

Do research to develop several S&T achievements to control population growth, improve the quality and health levels of our population, rationally develop and use

resources, protect the ecology and environment and defend against natural disasters, improve peoples' residential environments, and so on to improve China's social development situation.

To achieve these objectives, China's social development S&T work over the next 10 years should use the "Man and Nature Research Plan" and other things to concentrate on these key tasks:

1. For the population, the focus is on population control technology and on providing advanced S&T to improve our population quality. During the Eighth 5-Year Plan, focus on improving existing birth control technology, develop new types of contraceptive medicines and tools, strengthen research on superior quality births, and gradually establish a central-level demographic statistics and population dynamics management computer information system.

2. For medicine and public health, focus on research on prevention using Chinese and Western medicine for malignant tumors, cardiovascular diseases, major infectious diseases, local diseases, occupational illnesses, and so on; reinforce research on Chinese medicine and Chinese drugs and on Chinese medicine clinical practice, new types of drugs, and new types of medical apparatus and instruments.

3. Do geological surveys to study and resolve several key technical problems in mineral exploration. During the Eighth 5-Year Plan, focus on surveys and evaluations of mineral resources that are in short supply, undertake survey and development research on large ore base areas in Xinjiang for valuable heavy and nonferrous metals, provide a resource foundation for establishing a large mineral base area.

4. For water resources, establish a management science system, gradually solve the water shortage problems of north China and key cities. During the Eighth 5-Year Plan, propose strategic deployments and countermeasures for improvement of the Huang He and Chang Jiang and development of river basins, and establish rapid improvement trial points; propose programs and management methods for analysis of water resource supply and demand and optimized dispatching.

5. For marine development, do research on disastrous marine environment numerical forecasting and offshore environment key technologies, select the continental shelf and certain exclusive economically sensitive zones to conduct comprehensive survey trials and resource assessment, gain an understanding of natural environmental factors for China's islands and surrounding marine areas, propose comprehensive development and utilization programs.

6. For ecological and environmental protection and defense against natural disasters, the focus should be on studying environmental pollution prevention and control in urban and rural areas and on technologies for defending against major natural disasters and on providing S&T guarantees for all types of ecological systems, natural protection regions, ecological and environmental construction, national territory improvement, and so on. Be concerned with and strengthen research on global environmental problems. During the Eighth 5-Year Plan, focus on developing research on major technical problems in defending against disastrous weather, earthquakes, and geological disasters and reducing disasters in urban areas.

7. For social public security, reinforce research on new technologies for public security disastrous accident prevention, investigation, and punishment. During the Eighth 5-Year Plan, focus on undertaking research on security safeguards, reconnaissance, material evidence examination, and other technologies.

8. For a shift to electronics in tertiary industry, gradually establish a tertiary industry information network, accelerate the promotion of a shift to electronics technology in banking, finance, and tax collection, do R&D on technology and equipment for commercial circulation of goods and materials.

9. For social development integrated trial points and demonstration projects, during the Eighth 5-Year Plan we should try to establish about 30 of them and extend them throughout China so that work to use S&T to guide social development unfolds in a stable manner.

XI. Basic Research

Basic research is the backup force for S&T and economic development, the vanguard and source of new technologies and new inventions, and the cradle for training qualified scientific personnel.

The goals for basic research over the next 10 years:

1. Focus closely on strategic key points in agriculture, energy resources, materials, information, and other aspects of national economic development and on population, medicines, resources, the ecology and environment, national disasters, and other major issues to undertake multidisciplinary integrated research, provide a theoretical foundation and technical basis for resolving problems, and make several major achievements that attain advanced international levels.

2. Create a group of scientists who have profound academic attainments and substantial influence on the development of world science; gradually form a basic research staff dominated by top-notch middle-aged and young academic leaders with a rational structure.

3. Truly run key state laboratories and key research academies and institutes well that are involved in basic research, gradually form several multidisciplinary integrated scientific research centers. Create an excellent environment adapted to the development of basic research, establish and perfect a new structure of openness, circulation, integration, and competition.

During the Eighth 5-Year Plan, the main aspects and directions of basic research are:

1. Continue to support free selection of topics among scientists and maintain their number at about 20,000 projects.

2. For basic disciplines and applied basic disciplines with major impacts on national economic and social development and broad applications prospects, use achievements from research done through free selection of topics by scientists as a basis for selecting 200 to 300 key basic research topics.

The state will use separate major basic research plans to make arrangements for vanguard disciplines where major breakthroughs may be made during this century and where we have definite advantages and a leading status internationally, or for important basic research that has important applications prospects and that can foster China's geographic and resource advantages.

XII. National Defense S&T (Deleted)

XIII. S&T Personnel

Developing S&T, invigorating our economy, and allowing talented personnel to display their skills requires that we place reinforcement of China's S&T staff construction in a primary position in national construction.

The goals and tasks for the next 10 years are:

Make S&T staffs develop in a stable way in quantitative terms, move toward rationality in structures and levels, make significant improvements in scientific research levels. Train and create a top-notch S&T staff adapted to the requirements of our four modernizations and construction and with an ability to compete in international S&T.

1. Gradually base training of high-level S&T personnel on domestic sources, strive to manage several key universities well. Institutions of higher education are base areas for S&T personnel training, and scientific research organizations at the province, autonomous region, and municipality levels and above as well as large enterprises are important sites for S&T personnel training. We must organically integrate economic construction, scientific research, technology development, and personnel training.

Fully foster the role of institutions of higher education, focus on supporting several institutions of higher education in gradually turning themselves into both educational centers and scientific research centers to enable to them train high-level S&T personnel and have the capability of solving important state S&T problems.

Make full use of the working conditions in key state laboratories and departmental open laboratories, undertake basic research and high-tech research, train S&T personnel with profound academic attainments.

Pay attention to the role of advanced experts in industrial departments in training applied advanced personnel, implement on a trial basis integration of institutions of higher education with enterprises and scientific research academies and institutes for training graduate students. Uphold the system of on-the-job personnel applying for degrees and gradually expand on-the-job graduate student training. In addition, reinforce continuing education for on-the-job S&T personnel.

2. Reform higher S&T education, train the necessary personnel in basic disciplines, large numbers of personnel in applied disciplines, and substantial numbers of management personnel. All disciplines and specializations should focus on training to give students the ability to do comprehensive analysis and solve real problems and strengthen the adaptability of college graduates for future work. Education in special disciplines should focus on theoretical and practical training and reinforce practical training links in specializations and training in practical abilities.

3. Fully foster the role of S&T personnel. Leaders at all levels must be good at discovering talented personnel and uniting talented personnel and not stick to one pattern in using personnel. They should create an excellent environment for top-quality young S&T personnel to display their talents and use systems and mechanisms to gradually resolve problems in personnel displaying their skills.

Reinforce ideological and political work for S&T personnel, encourage them to strive to scale upward and make greater contributions to national modernization and construction.

4. Truly improve the working conditions and living treatment of S&T personnel. During the Eighth 5-Year Plan, maintain overall wage levels for S&T personnel at the wage levels of similar categories of personnel in enterprises under the system of ownership by the whole people. The government will provide scheduled subsidies for 10,000 experts who make important contributions. For S&T personnel that assume responsibility for state scientific research tasks, allocate special funds from state finances to provide post subsidies. Provide preferential treatment to S&T personnel who work in rural areas, frontier regions, underground, wilderness areas, and dangerous environments. Gradually implement a linkage between total wage bills and results for scientific research academies and institutes that have economic incomes.

Eliminate the lifetime appointment system for technical job titles, establish a regular job title promotion system, enable more top-quality personnel to reveal their talents.

Give preference to resolving the housing problems of middle-aged and young personnel who have made prominent contributions, personnel who have completed their studies and returned to China, and S&T personnel with advanced job titles. Include housing construction for scientific research units and institutions of higher education as one of the key points for capital construction investments in the Eighth 5-Year Plan and make preferential arrangements.

XIV. Soft Science Research

The soft sciences are a new realm for S&T development in the present era and have become an important part of China's S&T activities. Development of soft science

research is a reliable guarantee for achieving more scientific and democratic decision-making.

During the next 10 years, the main goals for China's soft science research work are:

1. Focus on major decision-making questions on using S&T to promote economic and social development, undertake multidisciplinary and multilevel comprehensive research, propose programs, countermeasures, and measures for resolving problems.

2. Use modern scientific theory, methods, and measures, track soft science developments in foreign countries in certain fields, strive to make several major breakthroughs, and create soft science research specialists with international influence to raise soft science research work to a new level.

3. Make full use of existing manpower and materials, adopt appropriate measures, establish and perfect soft science research networks, and support the development of S&T consulting activities to make it an important sector among tertiary industry.

During the Eighth 5-Year Plan, the key tasks for soft science research are:

1. Undertake medium and long-term research on S&T development strategies, major S&T policies, preferential S&T development fields, international development trends, and China's countermeasures, provide a scientific foundation for the state's macro decision making.

2. Study and formulate medium and long-term programs for reform of the S&T system, propose objectives, tasks, and programs for phased implementation, explore routes and forms for integrating S&T plan management with market regulation.

3. Undertake research to evaluate implementation of major state, department, and local economic and S&T policies, establish evaluation indices systems, evaluation models, and evaluation methods.

4. Continue to do research on basic theories and methods in the soft sciences, promote development and applications of soft science disciplines.

Twelve Major R&D Projects Named

92FE0708B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 19 Jun 92 p 1

[Article by Correspondent Gu Honghong [7357 3163 3163]: "China Intensifies Research and Development of Major Technologies. To Tackle 12 Special Projects During Eighth 5-Year Plan. Overall National Strength To Rise To New Level Following Project Completion"]

[Text] **Xinhuashe Despatch, Beijing 18 Jun** China has recently decided on 12 specific technologies as major national research and development projects to be undertaken during the Eighth 5-Year Plan, including complete 20 million ton class large open pit mining equipment.

According to a briefing that the Deputy Minister of Machine Building and Electronics, Lu Yansun [7120 3601 5549], provided today at the conference on Eighth 5-Year Plan major technological equipment research and development, during the Eighth 5-Year Plan, the country's major technology research and development goals are as follows: a technological level for complete plants at the advanced international level of the 1980's, and more than 80 percent of complete plants being China produced.

The 12 major technical equipment research and development projects that the agencies concerned have decided on are as follows: 20 million ton class complete open pit mining equipment; complete large thermal power generating equipment, complete 500,000 volt extra high tension transmission and transformer equipment, heavy duty cars for the Datong-Qinhuangdao Line and complete equipment for a marine coal transportation system, a complete 300,000 ton ethylene plant, a complete large scale chemical fertilizer plant, a complete large coalification plant, preliminary research on the Three Gorges key water control project equipment and a complete large hydropower generating plant; complete desert petroleum drilling and extraction equipment; air traffic control system equipment; specialized individual equipment and universal technology, and large scale metallurgy technology. Machine building and electronics industries nationwide have concentrated large numbers of their best technicians to assault these 12 technologies. Once these projects have been completed, not only will the country's overall power rise to a new level, but the level of the country's research and development of major technical equipment will reach new heights.

Reportedly, the technological assault to produce major technological equipment in China during the Eighth 5-Year Plan will center closely around requirements for building scores of large engineering projects. The projects concerned include: the Three Gorges hydropower station, phase 3 of the Baoshan Iron and Steel Complex, the Dexing copper mine, the Tarim oil field, and other key national construction projects.

Progress in Major Technical Equipment R & D

92FE0708E Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 92 p 1

[Article by Correspondent Ji Hongguang [1323 3163 0342]: "Swift Advances in Research and Development of Major Technical Equipment. Great Achievements During 9 Years of Effort; 83 Heartening Accomplishments"]

[Text] After 9 years of continuous work, China's research and development work on major technical equipment is moving ahead quite rapidly. A beginning has been made in mastering the key skills involved, and during the next several years we will be able to design and manufacture the equipment ourselves.

Nine years ago, the State Council made the decision to research and develop the key technical equipment needed for a number of major energy, communications, raw and processed materials, petroleum and chemical industry construction projects called for in national intermediate and long-range development plans, using the importation

of advanced technology from abroad as a basis. During the past 9 years, the Ministry of Machine Building and Electronics Industry has done the research and development work required for 10 state-stipulated key kinds of technical equipment, providing 83 major pieces of important technical equipment for key state projects. This included a 110,000 ton piece of equipment provided for the second phase of the Baoshan Iron and Steel Complex, the principal production standards for which reached the level achieved for the opening of the project's first phase. It also included the research and development of large thermal power generating units. Six 300,000 kw units and one 600,000 kw have been safely delivered. In addition, batch production has begun on 250-310 mm geared drilling rigs, 10 cubic meter power shovels, and electric powered 108 ton dump trucks and associated equipment for large open-pit mines. Small scale batch production of cooperatively manufactured equipment has also begun. Furthermore a large number of complete equipment has been provided including a full range of heavy duty cars for the Datong-Qinhuangdao Railroad, a complete 300,000 ton ethylene plant, and a complete large chemical fertilizer plant.

During the past 9 years, the Ministry of Machine Building and Electronics Industry has also trained a permanent corps possessing advanced skills in the preliminary formation of enterprises and entrepreneurial blocs that are able to tackle research and development of major pieces of technical equipment. Lu Yansun [7120 3601 5549] of the Ministry of Machine Building and Electronics Industry disclosed at a meeting on 18 June that a large piece processing base has been established at Huludao to do advance preparatory work for the Three Gorges project, and both the Harbin and Dongfang electromechanical plants have made models and done testing of large ship lifting equipment.

Computerization of Industries Examined

92FE0708A Beijing XIANDAIHUA [MODERNIZATION] in Chinese Vol 14 No 6, Jun 92 pp 12-15

[Article by Gong Bingzheng [7895 3521 6927]: "Development of Applied Computer Technology to Revamp Traditional Industries"

[Text] **The Key to Progress in Industrial Technology**

Electronic information technology and computer technology are the most dynamic, most rapidly developing, and most pervasive high technologies today. They are also the central and foremost modern sciences and technologies. Intelligent machines that combine computers with machine tools and power machines are the most advanced production tools in society today, and they represent a new generation of productivity. The level of research on and the scale of production of computers as well as the breadth and depth of their application are an important indicator of a country's level of modernization and its overall strength.

Traditional industries are the mainstay and the foundation of China's national economy. Use of microelectronic technology, particularly computer technology, to revamp traditional industries is an effective means for bring about premium quality, high output, low consumption, a rise in the labor productivity rate, and economic returns to accelerate the updating of products. It is an important technological support that powers technological progress and structural reform of traditional industries.

Computers, particularly the application of microcomputers to the testing and control of machinery and electrical equipment in assisting the designing and engineering of products, in guiding the scheduling of industrial production, in handling operations and in managing enterprises, as well as in automating industrial processes are major ingredients in the revamping of traditional industries. They now yield, and they will continue to yield, enormous economies of technology.

Applied computer technology consists primarily of computer-assisted design (CAD), computer-assisted manufacturing (CAM), computer-assisted testing (CAT), computer-assisted processing and planning (CAPP), computer numerical control (CNC), direct digital control (DDC), distributed capability computing systems (DCCS), flexible manufacturing systems (FMS), materials resources planning (MRP II), management information systems (MIS), and computer integrated manufacturing systems (CIMS). The active promotion of applied computer technology by all traditional industrial sectors, notably key established enterprises and large and medium size enterprises, during the Eighth 5-Year Plan is the key action and the road that must be taken to narrow the gap with developed countries and to improve product quality and enterprises' returns in order to realize the second strategic goal and the 10 year plan for China's modernization.

Trend of Development: Networking, Integration, and Smartening

With the swift development of microelectronics technology, microprocessors, and microcontrol devices, computer products have become increasingly diversified. From monolithic machines, single board machines, personal computers, work stations, super microcomputers, multicomputer systems, partial microcomputer networks, small computers, and medium size and large computers to huge computers, and the development of computer applications to networking, integration, comprehensiveness, and smartness, computers have penetrated every field of society and family life to spur progress toward an information society.

In 1990, world output of microcontrollers totaled 843 million, microprocessors 199 million, personal computers nearly 26 million, work stations nearly 300,000, and partial networks 1.514 million. American Microelectronics magazine reported that in 1990 the American, Japanese, British, French, German, and Italian computer data processing and software market had retail sales of $268.222 billion. This included hardware sales of $143.185 billion. Microcomputer retail sales worldwide totaled $89.276 billion in 1990, including $27.6 billion in microcomputer mainframes, $27.69 billion in peripherals, $12.1 billion in software, and $21.85 billion in services.

Accompanying the widespread advances in computer applications has been the 5 A's, namely, FA for factory

automation, LA for laboratory automation, OA for office automation, EA for engineering automation, and HA for home automation, all of which are very common in developed countries. CAD, CAT, CAM, CNC, FMS, DCCS, MIS, CAPP and computer-assisted engineering (CAE) have become integrated. Artificial intelligence expert systems have entered the application stage; and computer integrated manufacturing (CIM), and computer integrated production systems (CIPS) have become the principal direction of development in the automation of industrial production. Large numbers of typical examples have appeared in machinery, electronics, aviation, metallurgy, petrochemical, and light industrial enterprises. Information processing is developing from data processing, word processing, image processing, and sound processing toward knowledge processing and artificial intelligence. The modernization of management resulting from making products smart and the automation of production, as well as the automation of communications commands have spurred progress in the spread of information throughout society. Nationwide, supernational, and worldwide networks have become practical and are changing the pattern of social life.

China's Disparity and Problems

Despite China's accomplishments in the application of computers during the past several years, a vary great gap with developed countries remains, and it is widening in certain regards. The principal problems are as follows:

1. A 15 to 20 year gap with developed countries such as the United States and Japan exists in the range of computer applications and the number of machines in operation. Currently China has slightly more than 500,000 computers in operation. Although this represents a 125 fold increase over the slightly more than 4,000 computers in use in 1980, it is still at the level of Japan in the early 1970's. China has fewer personal computers in use than South Korea, and development of computer applications is uneven. Fewer are used in agriculture and business than in industry; fewer are used in northwestern China than in the southeastern coastal regions of the country; and quite a few enterprises have yet to adopt the use of computers.

2. The level of computer application is relatively low. In China today, most computers are individual machines performing individual tasks. Networking is just now getting underway. Efficiency in the application of existing computers awaits further improvement. Abroad, the degree of networking is high. In the United States and Japan, between 30 and 50 percent of personal computers are networked, and national or even trans-national computer networks have been built. In foreign countries, DCCS, CAD, and CAM are fairly commonplace, and a number of CIM systems are operating in machinery, aviation, and electronics plants.

3. Little Commercialization of the Results of Computer Application. During the sixth and seventh 5-Year Plans, more than 20,000 achievements were made in the computer field, but they have not been put to much use in practice. Application software has not been made practical, integrated or commercialized. For the most part, programming is done by hand, and standardization is poor. Unified planning and organization and coordination is lacking in the country's research, development, and spread of applied computer systems. The result is duplication at a low level, and a dispersal and waste of manpower, money, and materials.

4. Little Production of Chinese Computer Systems. China's computer industry is unable to provide the computer applications system complete equipment to go with the software and hardware. Today, foreign imports must be mostly relied upon for large scale information systems, as well as for key national project CAD systems and automated partial industrial control systems. An assortment of many different kinds of computers have been imported, and China does not have its own copyrights on software developed for imported systems.

Today, quite a few entrepreneurial units lack an appreciation of the important significance of computer applications, and of the impact on traditional modes of thought of the spread of computer applications. They lack the motivation, the manpower, and the money to adopt computers.

Development Goals and Standards

1. Goals For the Development of Computer Applications in China During the 1990's

The application of computers must proceed on the basis of needs for development of China's economy and society, and actual circumstances in each sector. It must take increase in economic returns as its nucleus and the technological transformation of basic industries such as energy, transportation, and raw and processed materials as its focus. It must aim at popularizing the application of computers principally in large and medium size enterprises, and in important key medium and small enterprises, placing under computer control production processes for principal products, and assisting the management of enterprises. It should aim at the building of 12 large information systems throughout the country, and substantial completion of the technological transformation of traditional industries to ensure fulfillment of the Eighth 5-Year Plan and the 10-year plan for national economic and social development.

During the Eighth 5-Year Plan, the application of computers should focus on serving the technological transformation of traditional industries as follows: computer-assisted design of major products, computerization of existing equipment, development of electromechanical integration and smart new products, control of major processing and production processes, and computer-assisted management of enterprises.

2. Overall Targets For the Development of Computer Applications in China By the Year 2000

Wider application of computers: The number of computers in use is to be as follows: Between 5 and 6 million microcomputers (personal computers); and between 80,000 and 100,000 small or larger computers. Computer use in China is to reach the level of developed countries

during the mid-1980's (and the level of moderately developed countries during the early 1990's). Output value of computer service industries is to reach 6 billion yuan.

Pervasive application of computers: The technical level of computer application is to reach that of developed countries during the late 1980's or early 1990's, between 20 and 30 percent of computers being networked. Central government ministries and commissions, provinces, municipalities, and counties, are to build nationwide multi-level networks. Some key enterprises are to build integrated data information and manufacturing systems (DIMS) and management control systems. Partial applications systems and applied products are to reach current international advanced levels and enter international markets. An applied information service network that covers most of the major provinces, municipalities, and prefectures is to be preliminarily established.

Specific Targets (Only Several Items Explained)

(1) CAD Application

By the end of the Eighth 5-Year Plan, 50 percent of large and medium size enterprise and design units are to have computer-assisted design, and more than 90 percent by the year 2000. For major medium and small enterprises, between 20 and 30 percent of principal products will use CAD by 1995, and between 40 and 60 percent by 2000.

CAD Coverage	1995	2000
300 Key State Enterprises	30-50 %	60 to More Than 70%
Large and Medium Size Enterprises in 3,000 Industries	15-20 %	30 - More than 50 %
30,000 Important Medium and Small Enterprises	5-10 %	15-More than 20%

The extent to which CAD is used means the ratio of CAD products to the total of all products. CAD coverage means the amount of CAD design work completed as a proportion of all design work.

(2) Kinds of integrated electromechanical products and their output value ratio

Ratio of main products that are electromechanically integrated in electromechanical industries:

	1995	2000
Variety rate	10-15 %	15-20 %
Output value rate	8-10 %	15-20 %

(3) Rate of Microcomputer Control Over Major Production Processes

	1995	2000
Large and Medium Size Enterprises	40-60%	80-90%
Medium and Small Enterprises	20-30%	50-60%

(4) Computer-Assisted Enterprise Management

	1995	2000
3000 Network-Managed Key Enterprises	60-70 %	95-100 %
12,000 Large and Medium Size Integrated Management Enterprises	50 %	80 %
Partially Computer-Managed Medium and Small Enterprises	20 %	50 %

Technologies Requiring Vigorous Development

1. Computer-Assisted Design Technologies

(1) Microcomputer CAD systems, engineering work station CAD systems, support software, and typical applications software.

(2) Geometric molding technology, engineering drawings and automated input and understanding technology, finite element analysis pre- and post-processing technology, and engineering data base management technology.

(3) CAD/CAM integration technology and CAD/CAM systems utilization and commercialization.

2. Computer Control Technology

(1) Serialization and commercialization of China-produced chemical industry control systems (including programmable control devices), as well as RAS-usable and applied technology.

(2) Serialization and commercialization of China-produced large graduated and distributed control system, and medium and small distribution control system software.

(3) Practical operating systems, distributed data bases, on-site industrial buses, and real communications network devices, as well as software and configuration software, and utilization and commercialization service for support software.

(4) Industrial user module building [1696 2875] methods, user dynamic characteristics and parameter differentiation technology, and CAD/CAM, FMS, DCCS system simulation technology.

(5) Efforts on CIM and CIPS key technologies and commercialization of results obtained.

3. Management Information System Analysis Technology

(1) Drawing up of management information systems [MIS] engineering development and design plans.

(2) MIS system serialization and commercialization, as well as the development of typical system applications software; and research on applications software generation and development devices.

(3) Distributed data base technology

(4) Application of policy support systems and expert systems to MIS.

Several Suggestions

1. All user units and industrial units should jointly identify a number of representative demonstration pilot project units and projects for computer applications, and organize cooperation among factories, schools, and institutes concerned for the building of number of enterprises that demonstrate various kinds of computer application system. Representative applications system demonstration pilot projects should be used to spur the building of complete applications systems, and to serialize and commercialize them. Their spread from single sites to wide areas should be organized to accelerate the development of computer applications systems, the results commercialized, produced in large numbers, and spread.

2. The State Statistical Bureau, the State Science and Technology Commission, and the Office for the Application of Electronics Information Systems of the State Council are to take the lead in organizing departments concerned to formulate computer applications technology equipment policy, to draw up equipment guidance, to define various kinds of typical plans, placement, and basic software and hardware platforms, to recommend the optimum equipment series, to guide enterprises in the selection of equipment to be purchased, and to use both domestic and foreign procurement sources, the emphasis being on the domestic.

3. Electromechanical industries and the computer industrial sector should hasten the overhaul of their product mix and their industrial structure, should hasten the commercialization and the industrialization of research results, should build more commercialized work stations and more industrial control computer, small computer, and peripheral production bases. In this way they can improve the reliability, the range and the performance-price ratio of Chinese-made computer systems, providing complete equipment for applied systems and basic systems such as CAD, CAM, DCCS, MIS with all possible speed for the revamping of traditional industries.

4. More building of computer information service industries. This includes the development and improvement of a nationwide computer applications system development and application service system, and the organization of electromechanical industries engaged in computer applications system research and development, as well as information service units for close cooperation with units in all trades and industries that are engaged in computer applications system and information services, thereby forming nationwide multi-level multifunctional computer information service industry "national teams," and "local teams." This provides a means for shaping a computer service network comprised of central and local government units at all levels that covers major industries and key areas to provide all sorts of technical services to grassroots level factories, mines, and business firms.

5. Implementation of economics of technology policies that help advance the application of computers—things such as investment and fund raising policies, import-export policies, standardization policies, economic preference policies, and software protection regulations that increase enterprises motivation and reduce obstacles for using new technologies such as computers. At the same time, sources of funds must be widened, state disbursements, bank loans, and enterprises themselves raising money used as means for gathering money. Risk investment and special credit must be set up to support the application of computers to the revamping of traditional industrial technologies. Policies must be drawn up to provide appropriate protection of imports and exports; encouragement given to the use of China-made equipment; and import substitution and efforts to export used as means of gradually entering international markets.

Shanghai's Strategy To Develop High-Tech, High-Added Value Products in 1990's

92FE0654B Taiyuan JISHU JINGJI YU GUANLI YANJIU [TECHNOECONOMICS & MANAGEMENT RESEARCH] in Chinese No 2, Mar-Apr 92 pp 53-55

[Article by Xiao Yuanzhen [5135 0337 4176]: "Shanghai's Strategic Choices for Developing High-Tech and High-Added Value Products in the 1990's"]

[Text] Developing high-tech, high-added value products and high-tech industrialization is the key to developing high technology.

Shanghai will face both domestic and foreign challenges during the 1990's. In foreign countries, we will encounter the challenge of surging development of the world's new technological revolution and readjustment and optimization of the international industrial structure and a wide variety of trade competitors compared to whom the international competitiveness of Shanghai's high-tech, high-added value products is far from adequate. We must find ways to strengthen our international competitiveness before we can hope to be equal and fight for a larger share of the international market. Within China, reform and opening up and technology imports have enabled the economies of several provinces and municipalities to achieve surging development and their rate of economic growth has already surpassed Shanghai's. Shanghai's import/export trade has now fallen to second place in China. Moreover, shortages of raw materials and energy resources, insufficient capital, and shortages of foreign exchange have become a "bottleneck" that restricts the development of high-tech, high-added value products in Shanghai. Facing this serious situation, Shanghai can no longer take the route of intensive development but instead must take the path of international-oriented and export-oriented development. Developing high-tech, high-added value products is the key to Shanghai's export-oriented economic development in the 1990's. This requires

Shanghai to use the international market as a guide, use science and technology as its advantage, actively participate in the international division of labor, international cooperation, and international competition, and make a new deployment.

I. Use High and New Technology As Motive Power, Develop High-Tech, High- Added Value Product Exports

In the 1990's, Shanghai's ideological understanding of the development of high-tech industry must be intensified. The strategic focus in developing high-tech industry should be focused on truly shifting from improving national defense to reinforcing our national strengths. Our present development of high and new technology is mainly to develop a high-tech economy and we should view it as a source of competitiveness and give it a vanguard status.

Trends of international market competition show that high and new technology is the source of motive power for high-tech, high-added value product development, and that the higher the degree of technological intensity of a product, the stronger its competitiveness in the market and the better its export and foreign exchange earning prospects. For Shanghai to adapt to currents in the international market, it must accelerate the intensification of its industrial structure. Intensification of the industrial structure and product mix in essence is optimization of technical results. Shanghai should adopt measures in two areas: 1) Make major efforts to adopt high and new-tech to upgrade traditional industry and traditional sectors, use it to achieve higher grades for traditional products as quickly as possible; 2) Actively open up emerging industries, strive to develop knowledge-intensive and technology-intensive industry.

Practice has proven that developing industry cannot be mixed together with developing production. Production is, of course, a link in the "chain" of industrial development (scientific research—technology development—product research—factory production—circulation and marketing—market services). The strategic principle for research and development should be shifted to enterprise R&D as the main factor to achieve high-tech industrialization.

The guiding ideology for expanded production and exports of Shanghai's high- tech, high-added value products in the 1990's should be: make the export- oriented economy the main battlefield, use the international market as a guide, use industrialization of S&T achievements as a breakthrough point, make industrialization of high and new-tech achievements the focus, make major efforts to develop Shanghai's high-tech, high-added value products, continually reinforce the export competitiveness of high-tech, high-added value products.

The basic objectives for expanded production and exports of Shanghai's high- tech, high-added value products in the 1990's should be: attaining international levels of the early 1990's for the overall levels of Shanghai's high-tech, high-added value products; the value of output of high-tech, high- added value products should account for more than 20 percent of Shanghai's gross value of industrial output; exports of high-tech, high-added value products as a proportion of Shanghai's export trade volume should rise to more than 40 percent; make Shanghai a key base area of the Far East for production and exports of high-tech, high-added value products.

II. Use Development of Pudong As a Turning Point, Develop High-Tech, High- Added Value Product Exports

The 1990's are the key decade for the development and opening up of Pudong, and building Pudong well is the primary task for Shanghai's economic development in the 1990's. In this important development period, Shanghai's economic development should adopt the tactic of transforming economic operational mechanisms to spur development of Pudong and use the development of Pudong to spur readjustment of Shanghai's overall industrial structure and deal with the relationship between Pudong [area east of the Huangpu] and Puxi [area west of the Huangpu] to "use Pudong to energize Puxi, use Puxi to promote Pudong". Pudong has an exceptionally advantageous economic environment and Puxi is richly endowed with technical forces. The development of Pudong will not only benefit the Pudong New Zone, but even more importantly it will have an effect on Shanghai as a whole and even all of China by allowing our abundant intellect, skills, achievements, patents, equipment, and other resources to play a major role in the springboard of Pudong. Moreover, it will also be able to stimulate rational readjustment of our industrial structure. It should be fully acknowledged that the development of Pudong is a long-term, arduous, and trans-century task. The primary goals for the industrial structure of Pudong will be a high starting point, multiple levels, and export orientation. While developing industry, it will also pay full attention to the development of S&T, banking, trade, and so on. The development of Pudong will mainly utilize foreign investments, especially by attracting direct investments by enterprises and large companies in foreign countries. The development of Pudong is the turning point for Shanghai's high-tech, high-added value product development and export expansion for the 1990's.

Facing the new situation in the development and opening up of Pudong, the pace of development of the three small open zones in Puxi (Caohejing Emerging Technology Development Zone, Minxing Economic and Technology Development Zone, and Hongqiao Economic and Technology Development Zone) should be accelerated during the Eighth 5-Year Plan to accumulate experience and train skilled personnel as an experiment zone for future rapid development of the three big open zones in Pudong (Waigaoqiao Bonded Zone, Qinqiao Export Processing Zone, and Lujiazui Banking and Trade Zone). Moreover, to develop Pudong with high speed, high levels, and high efficiency, I feel that in addition to the three development regions at Gaoqiao, Jinqiao, and Lujiazui that are now open to the outside world, we should get started as soon as possible with the Pudong Zhangjiang High-Tech Development Zone to allow it to play a better role in supporting the development of Pudong in S&T, industry, qualified personnel, and other areas. The focus of industrial development in Caohejing Emerging Technology Zone is to make

microelectronics, fiber optic communications, and bioengineering the main factor, whereas the industrial development direction for Pudong High-Tech Development Zone can be software, computers, automation technology, new materials, and marine engineering. Looking at the overall development of Shanghai in the 1990's and 20th Century, the two are coordinated with each other from afar, mutually supplementary, interrelated, and mutually promoting, and they will play an active role in promoting the formation of Shanghai's high-tech industry and in the development of high-tech, high-added value products and strengthening their international competitiveness.

III. Use Key Products as the Dragon's Head, Develop High-Tech, High-Added Value Product Exports

In the 1990's, one major key to the development of high-tech, high-added value products is focusing on development and scale production of dragon's head products, and electromechanical products will become a pillar of Shanghai's export products. Shanghai's 14 projects to attack key problems are the "dragon's head" for key breakthroughs and industrial formation during the Eighth 5-Year Plan. Completion of these projects alone will produce an additional 15 billion yuan in value of output. All of these projects are characterized by broad-ranging cooperation, substantial difficulty, technological intensity, and high added value. To concentrate our best troops for this storming of heavily fortified positions, we should further adopt the method of using the market as a guide and integrating economic measures with administrative intervention during the Eighth 5-Year Plan to foster Shanghai's powerful S&T strengths and its advantages of a well-matched and complete industry for optimized integration and joint attacks on key problems.

The automobile industry will become a pillar industry in Shanghai during the 1990's. Shanghai's automobile industry has now formed a substantial advantage in China with a yearly production capacity of 60,000 vehicles and a domestic production rate of 55 percent. During the Eighth 5-Year Plan, the domestic production rate will increase to 85 percent and yearly production capacity will reach 150,000 vehicles. In the year 2000, Shanghai's automobile production capacity will reach 300,000 vehicles and become an economic pillar both in name and in reality. The development of automobiles, which are high-added value products, will promote simultaneous development of Shanghai's materials, patterns, machinery, electronics, metallurgy, chemical, and other related industries.

Shanghai's light industry system was the first department to propose major efforts to develop high-tech, high-added value products and it has now formed several pillar-type high-tech, high-added value products. Since 1990, the value of output of 97 of the single products this bureau has developed and placed into production since 1990 has exceed 5 million yuan, and 19 of them have a value of output in excess of 20 million yuan. Statistics show that the system's value of output of high-tech, high-added value products now exceeds 50 percent of the gross value of output of its light industry products.

During the 1990's, Shanghai's high-tech, high-added value product development work must assemble together factors of production to form an export industry advantage. Continue to give primacy to the rate placed into production from start to finish, convert S&T achievements as quickly as possible into forces of production, further implement and perfect the "five big changes" in new product development: 1) A change from an extensive type to a technology- intensive type; 2) A change from digesting imported technology to doing their own development and innovation; 3) A change from single item product technology development to "integrated" product technology development; 4) A change from a substitution type to an export oriented type; 5) A change from a small batch type to a large batch type.

IV. Use the International Market as a Guide, Develop High-Tech, High-Added Value Products

The selection of target markets for exports of high-tech, high-added value products, which is also called a product positioning tactic, is an effective way to open up and expand the international market, and it can accurately guide the entrance of exported high-tech, high-added value products into the international market. Concretely speaking, it means placing the market environment and national conditions of relevant countries and similar categories of products produced by competitors in positions on a coordinate to determine the target market for product exports. By determining a target market for exports and using the market as a guide, the development of high-tech, high-added value products will greatly accelerate the pace of exports of Shanghai's high-tech, high-added value products.

The competitiveness of high-tech, high-added value products is composed of technology, techniques, costs, ability to meet contingencies, market sales, and other factors, with capital, skilled personnel, organizations, and subsequent product development capabilities serving as backup forces. Shanghai's high-tech, high-added value product exports are substantially competitive, especially the core parts of high-tech, high-added value product development and production—technology and skilled personnel—where Shanghai has definite advantages. However, market sales, organization, capital, and other weak links have weakened the competitiveness of Shanghai's high-tech, high-added value products, which is a problem that awaits solution during the 1990's. To further reinforce the competitiveness of Shanghai's high-tech, high-added value product exports and establish target markets for Shanghai's high-tech, high-added value product exports, we must do research on classification of international high-tech, high-added value products.

Category 1 is high-grade, precision, advanced, and technology-intensive high- tech, high-added value products. This category of products can also be divided into three overall levels. The first level is the United States, Japan, and Western Europe. The United States has technological advantages at this level, Japan has price advantages, and Germany has good quality. This is only a general and extensive concept, however, and their advantages are often

different for different types of products. The second level is the Soviet Union, Eastern Europe, and the emerging industrial nations and regions. The third level is the developing countries. At present, China is located between levels two and three. Products in this category are the dominant products in the industrially developed nations and the international market is basically divided up and controlled by them, meaning that the requirements for imported products are also very strict. It would be very difficult for similar types of products from Shanghai to enter these countries. Nevertheless, because of the large markets, good market response of products, and relatively high foreign exchange conversion rates in the developed countries, Shanghai's high-tech, high-added value products still have the necessary conditions to move into them. Southeast Asia and Eastern Europe are the primary markets for Shanghai's high-grade, precision, and advanced high-tech, high-added value products. Several countries in Southeast Asia are now industrializing but have not yet formed their own high-tech industry systems. For example, the countries of Southeast Asia basically do not have their own analytical instruments enterprises, and those they do have are merely divisions of large international corporations, so the varieties and prices of Shanghai's products are relatively well-suited to the national conditions of these countries. Computer and microelectronics technology of Eastern Europe and the Soviet Union lag about 3 to 5 years behind Shanghai's, so there is a substantial market there for Shanghai's high-grade, precision, advanced, and technology-intensive products. Thus, the target markets for our high-grade, precision, advanced, and technology-intensive products are mainly in Eastern Europe and Southeast Asia.

Category 2 is technology-intensive, capital-intensive, and labor-intensive high-tech, high-added value products like iron and steel, automobiles, ships, electromechanically-integrated products, and so on. In this category of products, levels in Japan and Western Europe are about the same as in the United States and some even lead the United States. The ranking of levels is basically similar to category 1 products. Products in this category have developed rather quickly in China over the past several years and the primary target markets for exports are Southeast Asia, Hong Kong, Eastern Europe, and Third World countries. Since the Sixth 5-Year Plan, with technology imports, technical upgrading, and joint investment and cooperative production, some of our products have already approached or attained international levels of the mid-1980's. Added to the gradual movement of the production of products in this category from the developed nations to other countries in recent years, the result has been that some of Shanghai's high-grade electromechanical, ship, and other products have begun to be exported to North America, Western Europe, and other markets.

Category 3 is traditional high-tech, high-added value products. The manufacturing industry for products in this category has already begun to decline in Europe and the United States. The ranking of levels for these products can roughly be listed as: level one is Japan; level two is Taiwan, South Korea, Hong Kong, Singapore, Thailand, Brazil, etc.; level three is the large number of developing countries. China can be listed as level 2. Unlike high-grade, precision, advanced, and technology-intensive high-tech, high- added value products, the primary target markets for exports of products in this category are the United States and other industrially developed countries, for example textiles, clothing, bicycles, and so on, but there is relatively intense competition to export these products and our competitors come from within China as well as from Hong Kong, Taiwan, South Korea, and the countries of Southeast Asia, and they are restricted by export quotas and other factors.

Doing research on classification of the three main categories of high-tech, high-added value products and analyzing the levels of exporting countries and export markets for high-tech, high-added value products will play an active role in correctly searching for target markets for Shanghai's high-tech, high- added value product exports and developing high-tech, high-added value product exports.

In summary, the key to reinforcing Shanghai's high-tech, high-added value product exports lies in trying in every possible way to strengthen Shanghai's international competitiveness in one realm. We must comprehensively improve our irrational management system, outdated concepts, the international environment, erroneous state policies and principles, and other factors.

Academy of Sciences to Change Mode of Operation

92FE0708D Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 9 Jul 92 p 1

[Article by Xinhuashe Correspondent Li Xiguang [2621 1585 0342]: "Chinese Academy of Sciences To Make Major Reforms. Mobility of Scientific and Technical Talent Encouraged For Improvement of Basic Research. To Become a High and New Technology Industry Development Base"]

[Text] Xinhuashe, Beijing 7 July Dispatch. The Chinese Academy of Sciences with its 90,000 research and development personnel has entered a crucial period of transition from an old system to a new one.

Chinese Academy of Sciences director Zhou Guangzhao [0719 0342 0664] said that this new system has been designed mostly with the young generation, China's future, and the 21st Century in mind.

Zhou Guangzhao said that the number of permanent personnel retained at the Chinese Academy of Sciences for basic research will number approximately 6,000, and the number of mobile personnel will exceed half the number of researchers. Approximately 6,000 of the researchers who have been working for a long time on surveys and the ecological environment will also be retained.

Zhou Guangzhao said that he hoped that under this new system young talent would be able to enter the Academy of Sciences steadily, and after 5 to 10 years of training that most will transfer out, a small number of those particularly

suited to basic research remaining as seeds to continue the steady development of basic research.

Zhou Guangzhao said that he had only three overall comments to make about Chinese Academy of Sciences basic research: first, that it win glory for the country, meaning it will have to be a leader in the world; second, that it will train talent for the country that is highly qualified and trained in basic research for work in all fields; and third, that once basic research shows results, it will make a contribution to development of the national economy.

Commenting on basic research work itself, Zhou Guangzhao said it must be on the forefront of science, meeting international standards. Real scientific research can only be first rate, not second rate. Without a certain amount of financial support, it is impossible for scientists to compete internationally. The Chinese Academy of Sciences will have to both organize a number of large projects and work on some freely selected topics. Scientists must be permitted to work completely free from restrictions.

Currently most of the major scientific research tasks that the state has proposed are being performed under the institute system, but in the future more will be gradually taken on by the corportion system.

Zhou Guangzhao said that the Chinese Academy of Sciences will certainly have to become a base for the founding and development of high and new technology industries nationwide. It will have to develop several comprehensive, externally oriented entrepreneurial blocs having an output value of more than 1 billion yuan made up primarily of high and new technology industries. It will have to develop a few score Silicon Valley style enterprises having an output value of up to 100 million yuan.

Industrial and Commercial Bank To Fund S & T

92FE0798C Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 26 Jun 92 p 1

[Article by Xinhuashe Correspondents Ding Jianming [0002 1017 6900] and Zhang Jinli [1728 6930 0500], "Industrial and Commercial Bank to Issue 3.5 Billion Yuan in Loans To Support Development of Science and Technology"]

[Text] Beijing 24 June. The correspondents have learned from the Industrial and Commercial Bank that the bank plans to issue loans totaling 3.5 billion yuan during 1992 to support the development of science and technology. This is to include a major tilt in credit toward the country's 27 high and new technology industry development zones.

Reportedly the state decided in 1990 that following development of the 27 high and new technology industrial zones, the building of China's high and new technology industry development zones will enter a period of vigorous development. In order to support the building and development of the high and new technology industry development zones, the Chinese industrial and Commercial Bank decided a few days ago that financial institutions in the development zones are to change their administrative and management mechanisms. Operating on the principles of relative independence, responsibility for their own operations, assuming risks themselves, and self-development, and functioning as enterprises, providing complete services, hiring their own personnel, and modernizing management, they are to become new style banks that are functionally complete, that provide advanced services, and that are scientifically managed.

Shareholding To Aid Local Science

40101022B Beijing CHINA DAILY (SHANGHAI FOCUS) in English 3 Aug 92 p 1

[Article by Chen Qide, CD staff reporter]

[Excerpts] China is hailing its first share-holding company in the scientific sector in this eastern metropolis.

Since the end of 1990, Shanghai, with the approval of the State Council, has launched 54 enterprises practising the share-holding system to date. On top of that, more than 100 local enterprises have applied to be share-holding companies.

As a share-holding system pioneer in the scientific sector, the Shanghai 3F New Materials Share-Holding Company Ltd., based at the Shanghai Institute of Organofluorine Materials, has signed a contract with the Shanghai Shenyin Securities Company to issue A shares worth 20 million yuan ($3.64 million).

With the anticipated 60 million-plus yuan ($10.91 million) raised by issuing A shares—the floating price per share is 34 yuan ($6.18)—the company will be powerful enough to step up its hi-tech industry, says general manager Teng Mingguang.

Currently, the institute has only 2.5 million yuan ($454,000) for scientific research per year. [passage omitted]

With the rapid development of the national economy, the demand for fluoromaterials is growing.

The new chemical products are hi-tech materials used for construction, electronics, machinery, automobiles, textiles as well as the aviation and space industries.

China started developing eteline, fluororubber and fluoroplastic in the 1960s, later marketing them on the civilian market.

The institute, set up in 1960 with more than 1,000 staff, has the capacity to turn out about 60 percent of the country's fluoroplastic and fluororubber.

"However, to enlarge production capability calls for considerable money," said Teng, who is also director of the institute.

The institute aims to develop Fluon, a Torch product approved by the State Science and Technology Commission, which needs an investment of about 20 million yuan ($3.64 million). [passage omitted]

With the shares, the company expects to launch a 500-ton eteline project, a 100-ton fluoroplastic project and a 200-ton fluororubber project, he said.

In addition, the company will set up two experimental factories in the Pudong New Area.

By 1996, the company is expected to achieve an annual sales volume of 100 million yuan ($18.18 million), bringing in 25 million yuan ($4.55 million) in profits and taxes.

Zhengzhou University in Forefront of Basic Research

92FE0708F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 92 p 1

[Article by Correspondent Qiao Di [0829 0966] and Reporter Yang Jituan [2799 0679 3273]: "Zhengzhou University Stabilizes Basic Research Corps, Perfects Research Mechanism, Improves Support, and Increases Exchanges and Partnerships"]

[Text] Zhengzhou University has taken various actions to stabilize its basic research corps, thereby scoring a large number of distinctive research achievements.

Since 1986, Zhengzhou University has followed the principle of assembling a crack research corps, establishing limited goals, and making key breakthroughs, stabilizing its basic research corps by perfecting its research mechanism, improving support, and increasing exchanges and partnerships.

First it established and perfected a research mechanism. In recent years, it has set up a number of research facilities meeting advanced international and domestic standards including particle physics, high energy physics, and chemical catalyst research laboratories and a modern chemistry research center, as well as a basic and applied scientific research institute. It has also purchased more than 21 million yuan worth of apparatus and equipment. In addition, it will use a World Bank credit of $2.3 million for an analysis and testing center and a computer center in which experimental, analytical, and testing methods will meet fairly high domestic standards, thereby providing conditions in which scientific and technical personnel can carry out basic research.

Second, it raised money in many quarters to improve support and encourage scientific and technical personnel to perform basic research. The school annually has more than 400,000 yuan obtained from various channels for basic research. This is more than 30 percent of its total scientific and technical financing, an amount far higher than the 15 percent of total financing available for basic research nationwide. In addition, the school also actively encouraged applied research and developmental research, obtaining both projects and financing from society at large and business concerns. It also paid out for basic research projects a substantial percentage of the scientific research funds and economic returns from developmental research that the university obtained. Each year the university registered and issued certificates for basic research achievements and issued awards to research personnel. Achievements in and level of basic research played an important role in promotions to higher positions and annual evaluations. The number of scientific papers published, grading and assignment of marks for achievements that won prizes, and the amount of work recorded were directly tied to compensation paid. One-time payments equal to 10 percent of the money available for project expenses were made to reward personnel doing basic scientific research. In addition, leaders in key academic fields were assigned outstanding assistants as a means of maintaining and making full long-term advantage of these fields.

The university paid extremely close attention to academic exchanges and partnerships, annually holding an average five or six large international academic exchange conferences, and selecting personnel to go abroad to work in advanced research institutions. It also established joint research with the United States, Japan, and Germany, and cooperative relationships for the training of talent, which created greater opportunities for basic research personnel to improve their professional skills.

As a result of the foregoing measures, the number of Zhengzhou University personnel doing basic research has long remained at approximately 40 percent of the total number of scientific and technical personnel. In recent years, they completed more than 100 state- and province-assigned basic research projects, and published more than 1,000 works, including a series of papers by Professor Wu Yangjieh [0702 7402 3381] on physical organic chemistry research and by Professor Cao Cewen [2580 4595 0795] et al on soliton theory and scientific and technical research making Zhengzhou University one of the rare specialized research centers in the world.

Using Foreign Experience To Nurture Top Talent

40101022A Beijing CHINA DAILY in English 28 Jul 92 p 1

[Excerpts] In another bid to bolster the morale of Chinese scientists at a moment when the country is stepping up its reform and opening drive, the government has pledged to let more talented people study or work abroad under better conditions.

According to a set of new regulations issued by the State Science and Technology Commission, the government will encourage more scientists to learn advanced technology and management experiences in foreign countries.

That will help Chinese scientists to achieve more and keep up with the latest scientific developments around the world. It will also push Chinese talent onto the international market.

China has benefited from its policy of sending scientists to work in foreign countries during the past 10 years. Many of them have become the leading scientists in their fields after returning home. [passage omitted]

The regulation also promises to continue to provide favourable working conditions and living standards at home, so as to attract Chinese scientists back to serve their country.

Meanwhile, according to the new regulation, Chinese scientists working abroad are expected to get more reasonable compensation. [passage omitted]

The new regulation said that the foreign salaries of such scientists will be guaranteed and protected.

Also, the regulation said that the pay to Chinese scientists working abroad should be comparable with that given to scientists by other countries.

Science Academy Researchers Sent to Industry

92FE0708G Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jun 92 p 1

[Article by Correspondent Zhang Yaguang [1728 0068 0342]: "Chinese Academy of Sciences Decides On a Fanning Out of Talent for the Founding of Internationalized Industrial Groups"]

[Text] Beijing Dispatch. The correspondent learned at the Chinese Academy of Sciences Enterprise Management Work Conference that the Chinese Academy of Sciences is in process of accelerating the pace of reform, doing all possible to play a greater role on the main battlefields of scientific research and the national economy.

The Academy of Sciences has decided to form various industrialized and internationalized consortia through the use of partnerships, mergers, and the stock share system, a number of business concerns who do a good job in the high technology field serving as mainstays. According to an April 1992 research report from the Beijing Municipal New Technology Development Experimental Zone, high and new technology concerns founded by Chinese Academy of Science scientists and technicians account for 10 percent of such concerns in the development zone; however, among the zone's top 50 major corporations in terms of total income from technology, industry, and trade, 16—or 32 percent—were founded by Chinese Academy of Sciences personnel. An authoritative person believes that "two support mechanisms in a single academy" lays a foundation for new magnificent Chinese Academy of Sciences goals.

- Raising of capital and establishment of risk funds to enable the rapid translation into production of a number of outstanding scientific and technical achievements. The Academy of Sciences Chengdu Biology Institute's Pharmaceutical Plant will invest 1 million yuan in a scientific research achievement—diao xinxuekang qijia [0966 1159 1800 5877 1660 6386 1367]. This plant has produced more than 1 million yuan in output value in the 3 years since its opening. The investment will be used to set up a business enterprise fund jointly with the Chinese Academy of Sciences to support China's increasingly urgent research work on new pharmaceuticals.

Rapid building of joint production, study, and research partnerships, using the Chinese Academy of Science's major achievements in plastic film technology and new materials to work with large and medium size business concerns in the establishment of high and new technology networks to hasten the formation of new industries.

Fanning out of talent, putting 70 percent of the human talent throughout the Academy on the main battlefield of economic construction, the remaining highly trained and capable forces engaging in basic research. Yet another group of personnel can operate tertiary industries that provide information and consulting as well as services needed in daily life. First pilot projects for comprehensive reform of the Chinese Academy of Science's Automation Institute is needed. The Automation Institute has nearly 600 staff members and workers of whom between 80 and 100 who make up a crack group in national laboratories will constitute a project research center in which they will continue to do basic research. They will be provided with operating expenses amounting to between three and four times the amount they have received heretofore. All the other staff members and workers will be transferred into the independent corporation system in which corporations themselves will operate research institutes. The corporations' mechanism will be used to transfer institutes, and the research institutes' skills will be used to transform the corporations.

Proposals for Educating, Developing S&T Leaders

92CM0318C Beijing ZHONGGUO RENCAI [CHINA'S PERSONNEL] in Chinese No 5, May 92 pp 7-9

[Article by Kuang Xinghua [0562 5281 5478], Cao Shangwei [2580 1424 0251], and Huang Xiaolong [7806 1420 7893]: "Proposals for Training and Nurturing S&T Leaders"]

[Text]

1. Concept of Leaders in Science and Technology Leaders

An important characteristic of the development of modern S&T is the increasingly detailed specialization taking place in scientific work. Scientific research can be distinctly divided into basic research, applied research, and developmental research. Both in the magnitude of human, material, and financial inputs and in the way research is organized and managed, basic research, including pure scientific research, on the one hand, and engineering and technological research of an applied and development type, on the other, each have their own special features. While pure scientific research and engineering and technical research each require their own experts, there are striking differences between the two groups of experts. Accordingly, we refer to the cream of the crop in the field of pure science as scientific leaders and the cream of the crop in the field of engineering and technology as all-round S&T leaders, while reserving the term "S&T leaders" to cover both groups.

Scientific leaders refer to the most outstanding scientists who have made major discoveries in scientific research

(essentially basic research) and have formed scientific groups revolving around themselves. What usually happens is that a large number of scientists collaborate in research under the leadership, organization, and coordination of a handful of the most outstanding scientists with the purpose of achieving a breakthrough in a particular area. Danish physicist and Nobel Prize winner Niels Bohr is deservedly called a model S&T leader. With his brilliant achievements and outstanding organizational abilities, Bohr brought together in Copenhagen in the 1920's and 1930's a host of the world's most talented physicists at the time, forming the well-known Copenhagen school and building the edifice of quantum physics.

All-round S&T leaders refer to the new-style scientists and engineers who possess exceptional organizational and managerial abilities in addition to having earned a reputation as experts in their fields. They are capable of putting together and organizing a group of scientists and engineers from different disciplines and areas of technology to undertake and complete major research, development, and test projects. In the course of implementing a project, they are decisionmakers, instructors, and direct participants (as principal scientist or chief engineer, for instance), on the one hand, and on the other hand, coordinators for and managers of the S&T personnel involved as well as for the entire project. All-round S&T leaders are a product of the great scientific era, having emerged from a handful of mammoth engineering and research projects. Robert Oppenheimer, the American who was put in charge of the "Manhattan Project"; Andrei Sakharov, "father of the atomic bomb" in the Soviet Union; and Qian Xuesen [6929 1331 2773], father of the rocket in China, are all eminent representatives of all-round S&T leaders. In the great scientific era, most S&T leaders come from the ranks of all-round S&T leaders.

2. China's S&T Leaders: Current Situation and Problems

These are times when China is taking a quantum leap. With S&T being the first productive force, China must no doubt rely on spectacular advances in S&T if it is to soar. China's achievements in the S&T in the last 40-some years demonstrate the overwhelming importance of S&T leaders. Looking ahead to the future, one sees S&T leaders as the most decisive factor. However, S&T leaders currently on the S&T front in China fall far short of what is needed to achieve a quantum leap in the nation's S&T, both quantitatively and qualitatively, and in terms of the role they must play.

First, China has a dire shortage of S&T leaders. A decade of turmoil has devastated the nation's scientific, technological, and educational undertakings, causing a gap in the ranks of China's corps of S&T personnel. Although China has more S&T personnel than many developed nations, and although it boasts a number of S&T leaders including Qian Xuesen, the famous scientist, most of them are already quite advanced in age. In contrast, few S&T leaders are in the prime of life. (What makes this a particularly acute problem is China's huge population base.) Thus the shortfall in S&T leaders is actually worse than it appears.

Second, the distribution of S&T leaders is uneven, first of all, in terms of discipline. China has made rapid advances in physics, mathematics, biology, mechanics, and aerospace, and it is in these fields that S&T leaders are relatively concentrated. Overall, however, the distribution of S&T leaders is grossly lopsided. In a number of traditional disciplines, "inbreeding" is flagrant, whereas in some newly flourishing areas, such as non-linear science, earth sciences, molecular neurobiology, environmental science, space science, and engineering science, not only is there an acute shortage of S&T leaders, but even the training of graduate students cannot keep up with the needs of scientific development. In those disciplines, therefore, no successors to the current generation of S&T leaders are in sight. Secondly, the distribution of S&T leaders is lopsided in terms of research type. Relatively speaking, S&T leaders are more plentiful in basic research, which explains why China ranks among the top in the world in high energy physics, superconductivity research, and molecular biology. In contrast, S&T leaders in applied and developmental research can be counted on the fingers of one hand. Yet it is the fruits of applied and developmental research that are more directly needed to fuel the development of the national economy. We can therefore say that China has a greater need for, but is more acutely short of S&T leaders in the fields of applied and developmental research.

Third, China lacks world-class natural scientists, as indicated by the nationalities of Nobel Prize laureates in the natural sciences field. The U.S., Britain, France, and Germany account for 89.9 percent of all Nobel Prize winners for science in the world, with the U.S. alone making up 46.6 percent. As for China, other than Yang Zhenning [2799 2182 1332] and Li Zhengdao [2621 2398 6670], who won the signal honor in the 1950's (at the time neither had obtained U.S. citizenship), all the scientists of New China have so far been locked out. Although a Nobel Prize winner is not necessarily an S&T leader, this shows at least there are few world-class players among China's S&T leaders.

Fourth, the overall academic standard of China's S&T leaders is low. For instance, of all S&T papers included in the United States' four leading indexing systems in 1987, China had less than 1 percent, more than Brazil but fewer than India. In terms of the rate of citation, China was only one-eighth that of the U.S., one-third that of Brazil, and one-half that of India. This not only shows that the quality of China's S&T papers is not high, cited only infrequently and exerting little international influence, but also indicates a significant gap between the overall academic standard of China's S&T leaders and those of their counterparts in advanced nations.

Fifth, while leaders and academic and technical pacesetters can be found in all areas and on all fronts in China's S&T, few of them really deserve the title of S&T leaders. What is absent is not so much academic expertise as a high

level of managerial ability. Ma Dayou [7456 1129 3731], the well-known physicist, hit the nail on the head when he said, "Nowadays some leaders in the high-tech departments seem to believe that everything would be fine if only they can lay their hands on money. This is actually muddled thinking. If nothing else, it shows that they are incompetent scientific organizers."

A multitude of factors has contributed to this state of affairs: some are historical, some are current; some have to do with people's subjective understanding, some are objective conditions (such as the overall backwardness of China's science, technology, and education), some are related to the S&T system, and others have to do with the way we turn out qualified people. A particularly important factor is that colleges and universities are not turning out the kind of qualified people that would become S&T leaders. As the training ground of advanced specialists, universities, particularly universities of science and engineering, should no doubt be the cradle of S&T leaders as well.

3. Some Proposals for the Development of S&T Leaders

Marx said, "Every society has its own giants. If it does not have them, it must create them." Since China, being at a period of taking a giant leap, has a desperate need for hundreds upon thousands of S&T leaders, we must "create" them.

Mencius said, "Gather together all people of outstanding talent under heaven and educate them." We must do more; we must "gather together all people of outstanding talent under heaven and use them." No doubt these two are the correct approaches to take to train and nurture a host of S&T leaders. Accordingly, we must begin by reforming higher education.

1) A small number of key universities of science and engineering should make the development of S&T leaders required by socialist modernization one of their primary missions. Toward that end, a model for teaching featuring a full lineup of disciplines and a comprehensive curriculum should be developed.

The S&T leaders China needs should be top-notch scientists and engineers who have faith in communism, are passionately devoted to the socialist cause, and possess all-round knowledge and abilities. A small number of key universities of science and engineering should deliberately turn out such people in accordance with a plan. Toward that end, appropriate selection and training methods should be adopted at every stage: recruitment, the undergraduate level, master's program level, doctoral program level, and postdoctorate level. In recruiting students, for instance, we must stress both basic knowledge and ability (for instance, the ability to apply knowledge creatively). At the undergraduate level, we should take pains to lay a solid foundation by offering a comprehensive range of courses so that undergraduate education imparts a good mix of knowledge combining science with engineering and management, and arts with science. Also to be stressed in undergraduate education is the development of ability. At the master's degree level, the objective should be to reinforce professional expertise and offer basic training in scientific research, and turn students into specialists in a particular field. In the doctoral stage, the individual takes up a specific scientific research project as a way of becoming a scientific researcher at an advanced level. In the postdoctoral stage, he engages in research in a key national scientific research project under the guidance of a famous scientist and is put in charge of the management of scientific research within a specified area. Beginning at the postgraduate level, we should take special care to train those young people who have a sharp mind, a keen insight, and good organizational abilities, in addition to being highly learned. The reason is that only this type of person can evolve into the S&T leader of the future.

To train these S&T leaders, as well as meet China's urgent need for large numbers of well-rounded S&T personnel, China's leading universities of science and engineering and colleges of engineering must revise their concept of education, establish new educational ideals, and transform what used to be a simple university of science and engineering (particularly college of engineering) into a new type of university that combines science and engineering with the humanities, social sciences, and management in order to offer a full lineup of disciplines and courses, enabling the student to acquire a comprehensive body of knowledge and a full range of skills. When it comes to the training of graduate students, particularly at the doctoral level, universities must make courses on the organization and management of scientific research a requirement. These courses will be of special relevance to them. In the great scientific era, becoming comprehensive is the dominant trend in the development of scientific and engineering education today as well as in the development of S&T itself. Without becoming comprehensive, the university of science and engineering will not be able to turn out people that are up to standard, let alone S&T leaders.

In training S&T leaders, we also must take pains not to favor any particular discipline. The need to train and nurture S&T leaders applies to every discipline. Also, we must not limit the movement of outstanding individuals. Instead, as part of an all-out effort to optimize the mix of China's corps of S&T leaders in the not too distant future, we should encourage some of them to switch to fledgling, interdisciplinary, and marginal areas where there is an acute shortage of S&T leaders, but whose development is central to China's S&T future.

2) The state should set up an advanced level university or college for S&T organization and management to train advanced-level S&T managerial scientists, including S&T leaders, using the continuing education format.

Qian Xuesen has noted many times that the organization and management of scientific research is a piece of systems engineering, specifically, scientific research systems engineering. He said, "The organizational and managerial scientists and systems engineers we need will absolutely not be fewer in number or lower in quality than the natural scientists or the ordinary engineers." "Judging from the future development of S&T research in China, the number

of managerial and organizational personnel in our corps of scientific researchers will far exceed one million in the next century." Therefore, he has proposed "the creation of a type of institution of higher education that integrates science with engineering and nurtures S&T personnel skilled in organization and management." The proposal of this world-renowned scientist cannot be ignored. In our opinion, a school or department of S&T management should be set up at every university of science and engineering in order to train a huge number of rank-and-file managerial cadres for scientific research. Furthermore, China should set up at least one advanced-level institution—a national university (college) for S&T management—modeled on the National Defense University, that will devote itself to the training of senior scientific research managerial personnel. Given the characteristics and quality of S&T leaders, it will take more than an academic education to train them. Enrollees in the national university of S&T management should be selected from among working scientists and engineers with a PhD and significant accomplishments in S&T and who have demonstrated through practice a formidable talent for organization and management. Since its students are working scientists and engineers, the national university of S&T management should train S&T leaders using the continuing education format.

3) The chief method of training S&T leaders is to boldly put them through the practice of S&T modernization and expose them to the larger environment of global S&T development.

Addressing the national S&T work conference, Comrade Deng Xiaoping said, "Create an environment where top-notch people can demonstrate their talents." The environment for "practice," an "open environment," we say, is precisely such an environment.

Surveying S&T leaders at home and abroad, we can hardly find anyone whose training took place entirely in academia, as all of them have emerged from a long period of actual work in scientific research. To a certain extent, they were born of the needs of research, development, and experimental work. Therefore, we must boldly let them be the technical leaders of major national or local scientific research projects, giving them responsibilities as well as power so that they can fully utilize their creative abilities. Only by putting them through the mill can we harvest a crop of S&T leaders worthy of the name. When Oppenheimer was first entrusted with the "Manhattan Project," he imagined that it would take only 30 scientists or so to put together an atomic bomb. Only when the project was under way did he gradually mature in many respects. Our own Qian Xuesen, Qian Sanqiong [6929 0005 1730], and Yuan Longping [5913 7127 1627] also became leaders after the completion of their research missions rather than arrived at an important job already established as leaders. In training S&T leaders, therefore, we must adhere to the principle of practice. In other words, we must look for S&T leaders from among those who have completed a major national S&T project. We should take special steps to give priority to the training of new leaders with exceptional promise so as to speed up their maturation. As Comrade Deng Xiaoping said, "Build them a lighter ladder so that they can climb it by skipping a rung or two." The only way to turn them into the S&T leaders so badly needed in modernization is to boldly give them major responsibilities and improve them by means of continuing education, founded on practice.

Seldom has a scientist, Chinese or foreign, become a S&T leader in a closed environment. Whether the aim is to turn out a first-rate scientist or a first-rate manager, we must nurture the S&T leader in an open international environment. This is particularly true for a country like China where science, technology, and education are relatively backward. Nankai Mathematics Institute, headed by Prof. Chen Shengshen [7115 4164 6500], the world-famous mathematician, hosts an annual meeting each year to study a particular topic, attended by first-rate scholars from all over China and around the world. There are seminars, lectures, and academic exchanges in order to find research orientation, develop young talent, and search for a way that would help to make China a mathematics power quickly. The meetings are lively and full of promise. Therefore we must firmly continue the practice of sending students and visiting scholars overseas so that we can do a better job in ideological education. In particular, we must give potential S&T leaders plenty of opportunity to go to advanced nations as visiting scholars and to observe and study; we must simplify their exit examination and approval procedures, and encourage them to interact with world-famous scientists and organizational and managerial experts and absorb advanced foreign S&T and management.

The times are calling for S&T leaders. In the midst of socialist modernization, China has a special need for S&T leaders. We should put the training of S&T leaders on the agenda in a serious way.

Viscous Shock-Layer Numerical Calculations of Three-Dimensional Nonequilibrium Flows Over Hypersonic Blunt Bodies at High Angle of Attack

40100075A Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 3, Jul 92 pp 1-12

[English abstract of article by Ouyang Shuiwu and Su Yuhong of the Beijing Institute of Aerodynamics; MS received 9 Jan 91]

[Text] The hypersonic, nonequilibrium, viscous shock-layer equation numerical calculation procedure for a multi-component mixture of reacting gases is described. In present work, three-dimensional flowfields over the re-entry blunt bodies at high angle of attack, chemical specie mass fractions, skin-friction coefficient, and heat transfer rates are discussed. The viscous gas flows are considered to be seven-component ionizing air. It is assumed that the chemical reactions proceed at finite rate. The present numerical method uses a general orthogonal curve-coordinate computational grid system to treat three-dimensional blunt body flowfields. The equations, including ξ-momentum, ζ-momentum, energy and species conservation equations, are solved by a finite-difference scheme.

Since these equations are second-order parabolic in the computational coordinate system, the element-tridiagonal system resulting from the parabolic equations by an implicit finite-difference scheme gives the simultaneous linear algebraic equations which are solved for flows under a fully catalytic surface condition. The block-tridiagonal system is derived from the continuity and normal momentum equations but they are coupled together and solved by a similar method. Three-dimensional computational results have been obtained for a re-entry blunt vehicle at 10° angle of attack.

Improvement of Manufacturing Process and Analysis of Tensile Strength of SiC/Al Preform Wire

40100075B Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 3, Jul 92 pp 43-48

[English abstract of article by Wan Hong and Yang Deming of the National University of Defense Technology; MS received 17 Apr 91]

[Text] By improving the manufacturing process, NICALON SiC multifilament reinforced Al preform wire was obtained with tensile strength of 1,000 MPa. The microstructure of wires is analyzed with scanning electron microscope. It is found that the improvement of the interface bond is the main reason for the increased strength. Further possible improvement of the wire is proposed. The effects of thermal exposure on the wire strength are also investigated.

Study on Fatigue Crack Propagation Behavior in Al-Li 2091 Alloy

40100075C Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 3, Jul 92 pp 49-56

[English abstract of article by He Shiyu, Li Qingjian, and Feng Xiaozeng of the Harbin Institute of Technology and Zhang Jun, Gao Guozhong, and Wang Zhongguang of the Institute of Metal Research, CAS; MS received 25 May 91]

[Text] The fatigue crack propagation (FCP) behavior of Al-Li 2091 alloy in different aging states and in different environments is studied. The microstructures and fatigue fracture surfaces of the alloy are examined by using TEM, SEM and optical microscope. The results show that in ambient air, under-aged alloy has the lowest FCP rate and the highest FCP threshold, and over-aged alloy has the highest FCP rate and the lowest FCP threshold, while peak-aged alloy is between them. It is shown that peak-aged alloy has lower FCP rate and higher threshold in ambient air than in air of 130°C or in 3.5 percent NaCl aqueous solution. The alloy in air of 130°C has higher FCP rate and lower threshold than in 3.5 percent NaCl aqueous solution. The relationship among FCP rate, crack path and microstructure is discussed.

The Influence of Thermal Aging on Crosslink Density of HTPB Propellants

40100075D Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 3, Jul 92 pp 77-85

[English abstract of article by Zhou Jianping and Li Aili of the National University of Defense Technology; MS received 18 Mar 91]

[Text] The influence of thermal aging on the crosslink density, relative number of crosslinking bonds (RNB) and percent gel are studied by high-temperature accelerated aging tests. The crosslink density is measured by swelling-compressing method and is calculated by the formula derived from the three-phase sphere model which is used in the mechanics of composite materials. The RNB and percent gel are measured by swelling-weighting method. The experimental results show that the general trends of these three parameters with time are similar. The relaxation modulus of the material can be taken as a linear function of crosslinking density.

Improvement on OCOG Algorithm in Satellite Radar Altimeter

40100075E Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 3, Jul 92 pp 92-98

[English abstract of article by Yu Tao and Jiu Dehang of the Xi'an Institute of Space Radio Technology, CAST, P.O. Box 165, Xi'an, P.R. China; MS received 23 Apr 91]

[Text] The Offset Centre of Gravity (OCOG) algorithm is a new tracking algorithm based on estimate of the pulse amplitude, pulse width and true centre of area of the pulse.

It is obvious that this algorithm is sufficiently robust to permit the altimeter to keep tracking many kinds of surfaces.

Having analysed the performance of this algorithm, it is discovered that the algorithm performs quite satisfactorily in high-SNR [signal-to-noise ratio] environments, but fails in low-SNR environments. The cause of the degradation of performance is studied and it is pointed out that for the Brown return model and the sea-ice return model, the performance of the OCOG algorithm can be improved in low-SNR environments by using a noise gate.

Scanning Tunneling Microscope Used for Nanometer-Scale Processing

92P60423A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 8 Aug 92 p 1

[Article by Huang Yong [7806 0516]: "Scanning Tunneling Microscope Displays Invincible Might"]

[Summary] Beijing, 7 Aug—A new breakthrough has been made in nanometer-scale materials processing: CAS Institute of Chemistry and Beijing Vacuum Physics Laboratory scientists recently used their independently developed scanning tunneling microscope (STM) to etch 200 nm x 200 nm characters onto the surface of graphite crystals. In a computer-controlled process, the scientists moved the STM probe over the surface and etched out the characters "Zhongguo" ["China"], the letters CAS, a 1:1 x 10^{13} map of China, and the Olympic logo reduced to the same area. CAS Institute of Chemistry associate director Bai Chunli [4101 2504 4409] remarked that these scientists have been able to repeatedly etch out lines only about 10 nm wide—far surpassing the 0.25-micron-line-width IC fabrication precision of the international state-of-the-art. This breakthrough will have important applications in nanoelectronics, such as in the fabrication of high-density memory elements and nanometer-scale electronic components.

Fracture Behavior and Fracture Toughness of Al-2.5Li-1.3Cu-0.9Mg-0.13Zr Alloy

40100077A Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 28 No 7, Jul 92 pp A318-A322

[English abstract of article by Wu Yilei, Qiang Jun, et al. of the Institute of Aeronautical Materials, Beijing; MS received 15 Jul 91, revised 14 Dec 91]

[Text] The fracture mechanism for Al-2.5Li-1.3Cu-0.9Mg-0.13Zr alloy is quite different after undergoing various regimes of heat treatment. With the decrease of solution temperature and the increase of aging temperature, the intergranular delimitation and necking fracture on the fracture surface increase and the shearing fracture decreases. Thus, the toughness of the alloy may be much improved.

Effect of Oxide Layer Thickness Over Al and Al Alloy Powders on Quality of Their Explosive Compacts

40100077B Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 28 No 7, Jul 92 pp B312-B315

[English abstract of article by Zhang Dengxia, Ma Chenghui, and Cai Ming of the Institute of Mechanics, CAS, Beijing, Ai Baoren, Zhang Jinyuan, et al. of the Central Iron and Steel Research Institute, Ministry of Metallurgical Industry, Beijing; MS received 18 Mar 91, revised 16 Nov 91]

[Text] Observations of microstructure of explosive compacts made of Al or Al-Li alloy powders by atomization with water, nitrogen or ultrasonic Ar gas were carried out under optical and scanning electron microscopes. The results indicate that super-quality explosive compact can only be obtained by powders of which the thickness of the oxide layer is less than 30 nm.

Microstructure and Mechanical Properties of In-Situ Formation Fibrous Polytype AlN Composite Material

40100077C Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 28 No 7, Jul 92 pp B328-B332

[English abstract of article by Li Zonghuai, Chen Shengqi, et al. of the Institute of Metal Research, CAS, Shenyang; MS received 7 Aug 91]

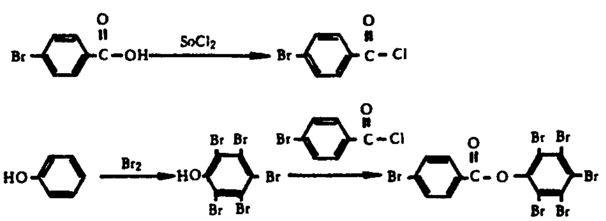
[Text] In-situ formation fibrous polytype AlN composite ceramic material was prepared from AlN-Y_2O_3-SiO_2 system. In comparison with AlN ceramics, both bending strength and fracture toughness of the composite material are much better. Microstructural observation reveals that a lot of epitaxial growth fibrous AlN polytype occurred in the matrix. Y_2O_3 seems to act as a densifier for in-situ formation material and as a medium for growth of fibrous polytype. SiO_2 is the growth promoter for fibrous polytype. The occurrence of fibrous polytype may increase the strength and toughness of AlN ceramic composite material.

Synthesis of 2, 3, 4, 5, 6-Pentabromophenyl 4-Bromobenzoate

40091020A Qingdao QINGDAO HAIYANG DAXUE XUEBAO [JOURNAL OF OCEAN UNIVERSITY OF QINGDAO] in Chinese Vol 22 No 3, Jul 92 pp 113-116

[English abstract of article by Qian Zuoguo [6929 0146 0948], Wang Yanjun [3769 3601 0689], and Sun Mingkun [1327 2494 2492] of the Department of Marine Chemistry, Ocean University of Qingdao. This work was subsidized by the Natural Science Foundation of Shandong Province.]

[Text] A number of polybrominated aromatic compounds can be used as fire-retardants. In this field, the Department has made a study of some brominated organics which are of interest to industry. This preliminary communication reports a new polybrominated aromatic ester, 2, 3, 4, 5, 6-pentabromophenyl 4-bromobenzoate which can be synthesized from phenol and 4-bromobenzoic acid by a three-step reaction:



The synthetic method of 2, 3, 4, 5, 6-pentabromophenol (as an intermediate product) described in this paper has the advantage of fewer steps and higher yield as compared to the classical method. Anhydrous aluminum trichloride has been used to catalyze the perbromination of phenol.

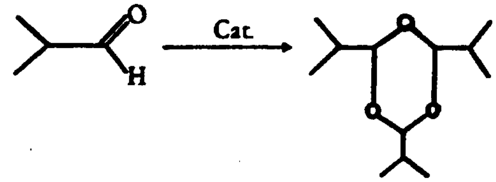
An Improvement on Synthesis of 2, 4, 6-Triisopropyl-1, 3, 5-Trioxane

40091020B Qingdao QINGDAO HAIYANG DAXUE XUEBAO [JOURNAL OF OCEAN UNIVERSITY OF QINGDAO] in Chinese Vol 22 No 3, Jul 92 pp 117-121

[English abstract of article by Qian Zuoguo [6929 0146 0948], Liu Xiang [0491 5046], Zhang Ying [1728 4481], and Sun Mingkun [1327 2494 2492] of the Department of Marine Chemistry, Ocean University of Qingdao]

[Text] This paper reports a procedure in which cyclohexane was used as solvent for the synthesis of 2, 4, 6-triisopropyl-1, 3, 5-trioxane from isobutyraldehyde by cyclic trimerization. It has the advantage of higher yield and lower toxicity than those when benzene was used as solvent.

As one of fine chemicals, 2, 4, 6-triisopropyl-1, 3, 5-trioxane is an innoxious, odorless, non-irritant and sublimable white crystal, and it has been found that its considerable uses are as support of volatile preparation in formulating telephone disinfectant, wool-mothicide, slow-releasing insecticide, solid fragrance preparations and deodorant etc. It is commonly synthesized by cyclic trimerization of isobutyraldehyde in the presence of catalysts.



Effect of Toxoflavin on the Action of Xanthine Oxidase

40091019B Beijing SHENGWUHUAXUE YU SHENGWUWULI JINZHAN [PROGRESS IN BIOCHEMISTRY AND BIOPHYSICS] in Chinese Vol 19 No 2, Apr 92 pp 119-122

[English abstract of article by Ren Weidong [0117 4850 2767], Zhao Naixin [6392 0035 2500], et al. of Weifang Medical College]

[Text] The kinetic studies of effect of toxoflavin on the action of xanthine oxidase (EC1,2,3,2) which was extracted from *Pseudomona cocovenenans* showed that toxoflavin was nonessential activator for the enzyme, and the activation in condition of hypoxanthine as substrate was more marked than xanthine. The activation obeyed the partial activation type. These results provide us a clue for searching toxic mechanism of toxoflavin for human.

High-Level Expression of Glycoprotein 52 kD Antigenic Domain of Human Cytomegalovirus in *Escherichia Coli*

40091019A Beijing SHENGWUHUAXUE YU SHENGWUWULI JINZHAN [PROGRESS IN BIOCHEMISTRY AND BIOPHYSICS] in Chinese Vol 19 No 2, Apr 92 pp 105-110

[English abstract of article by Wu Jun [0702 0971], Chen Junjie [7115 0193 2638], et al. of the Department of Pediatrics and Department of Biochemistry, West China University of Medical Sciences, Chengdu, Gu Jianren [7357 1696 0086], Wan Dafang [8001 1129 2455], et al. of the Department of Biochemistry and Molecular Biology, Shanghai Cancer Institute]

[Text] The human cytomegalovirus (HCMV) glycoprotein 52 kD gene was cloned and the DNA sequence of antigenic domain of this gene was amplified with polymerase chain reaction (PCR) technique. The sequences of oligonucleotide primers are 5'-AAAGAATTCATGAACGTGAAG-GAATCG-3' (upstream primer) and 5'-ATAAAGCT-TAATTCAGACGTTCTCTTCTTC-3' (downstream primer). The PCR product was purified and digested with EcoR I, and then inserted into the EcoR I digested expression plasmid pBV-220. The cloned gene was expressed under control of the hybrid P_RP_L promoter in *E. coli* following induction at 42°C for 2h, 4h and 6h, respectively. The proteins in the lysate of bacteria were analysed by using 12.5 percent SDS-PAGE. The predicted protein 12 kD expressed from the cloned gene in *E. coli* was observed and harvested. Up analysing the antigenic domain of

HCMV glycoprotein 52 kD, a polypeptide in length of 25 amino acids was synthesized, of which sequence is Phe-Asp-Leu-Glu-Glu-Ile-Met-Arg-Glu-Phe-Asn-Ser-Tyr-Lys-Gln-Arg-Val-Lys-Tyr-Val-Glu-Asp-Lys-Val-Val. The expressed protein and synthetic polypeptide were used to immunize rabbits respectively, and two kinds of antisera reacted with the expressed antigen and HCMV AD 169 antigen detected by using ^{125}I-labelled protein A. The results of Dot-blot and Western transfer show that the protein expressed from the cloned gene has the same band in size and specificity of antigen as those of the synthetic polypeptide. By using horse radish peroxidase (HRP) labelled IgG instead of ^{125}I-protein A, preliminary result indicated the diagnostic value of the expressed protein and its antiserum for the HCMV infection.

Domestic Export Software Industry Profiled—Interview with Six Shenzhen Firms

92FE0615 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 13 May 92, No 20, 20 May 92, No 21, 27 May 92

[Article in three installments by JISUANJI SHIJIE special reporter Liu Keli [0491 0344 7787]: "What Is the Promise of China's Software Industry?—A Survey of Shenzhen's Software Industry, With Reflections"]

[Part I No 19, 13 May 92 p 2]

[Text] Editor's note: JISUANJI SHIJIE special reporter Liu Keli recently spent a week visiting six representative computer software enterprises (including hardware manufacturing plants) in the Shenzhen region. What he saw and heard inspired him and the issues he reports are cause for deep thought. The full article is being published in three parts.

The world's yearly value of output of software is more than $100 billion, and it is growing at a 20 to 30 percent annual rate.

China is a country with the largest population in the world as well as a nation with abundant software intellectual and labor resources. What is the promise of China's software industry?

I visited the software enterprises Shenzhen Dashen Data Processing Company, Shekou Xinxin Software Company, Wanguo Software Development Company, Huada Computer Software Company, Dalong Electronics Company, Ltd., and Great Wall Group South China Base Area during mid-April 1992.

I learned during my 8-day visit that Shenzhen now has more than 150 software institutions that had a total volume of exports of $10 million in 1991 and a volume of sales in the domestic software market of more than 20 million yuan renminbi. They include more than 40 key enterprises that are now developing with a flourishing momentum and expanding the domestic and international markets for their products. The total volume of sales of Shenzhen's software industry in the domestic and international markets may surpass 100 million yuan renminbi during the next 2 to 3 years.

The information I obtained indicates that the value of output of software from Beijing, Shanghai, and other large cities is less than in Shenzhen and that the technical content, development models, and development scales of their software products cannot be compared with Shenzhen's. Within Shenzhen's software industry, whether it is Chinese-foreign joint investment or cooperative enterprises or state-run independent enterprises, all of their development models have a great variety, and a hundred flowers are blooming in their market channels and product varieties.

If I had not seen it myself, I would have found it hard to believe that the Dashen Data Processing Company has a 70-meter long and 20-meter wide record entry room. They are now entering the records of an already developed map system that will be used in 1995 Japanese automobiles and will then install it on optical disks. After this optical disk is installed in a car, it will use satellite navigation and have a physical error of less than 30 meters.

Dashen Data Processing Company was established in June 1986. It is a joint investment software enterprise of the Shen-Han (joint investment by Shenzhen and Wuhan University) S&T Industry Company, Ltd. and Japan's Osaka Computing Center. It now has 20 million yuan renminbi in fixed assets and a 4,000 square meter plant building and has installed 320 text entry computers, 130 (with CD disks) computers, 55 SUN4 workstations, and one IBM4381 large computer. "Dashen", which has 560 employees, has maintained its foreign exchange earnings from software exports each year at more than $2 million for the past 5 years. During the next 2 to 3 years, this company's volume of software exports will reach $6 million a year.

"Dashen's" Software Engineering and Development Department is now preparing to expand from 40 to 110 people. They have already developed several 100 products including a census register management system, telephone number management system, court case document system, and others. Although these products are now being utilized by users in Japan, they still have to add data documents almost every month.

I discovered during my visit that the unique loan arrangement and loan repayment method used by Dashen Company during the early period of its establishment deserves mention. At the time, the Osaka Computing Center borrowed several 10 million yuan from the Bank of Japan to purchase computer equipment. After this, Dashen Company used its own software product exports to repay the loan and after a few years Dashen Company had obtained all of the fixed assets it owns at the present time.

Dashen Company has displayed the advantages of software cooperation between institutions of higher education and foreign businesses in many areas like scale, value of output, product technical content, and so on. This is especially true of their loan arrangement, which can provide substantial enlightenment to computer industry circles, which presently have extreme shortages of capital.

If I say that Dashen is the biggest data processing company I have seen in China, then Xinxin Software Industry Company, Ltd. located in Shekou deserves its name of the "software plant". Their multimedia software export commodities are unparalleled in China and have caused a sensation in China's computer software circles.

In a research office in the Xinxin Company, I personally saw the "[Aircraft] Pilot School Examination System" [see JPRS-CST-92-012, 18 Jun 92, p 58] that has been exported to Hong Kong being displayed on the computer screens. This system fuses the personal history and photograph of the person being tested, the examination topics, and the touch keyboard real-time dynamic and sound software into a single entity. The testing process that took 1 day using traditional methods has been shortened to 1 hour. It also arbitrarily selects the examination questions for each

person taking the test from a question database and combines them to prevent cheating.

In another research office, I saw the exquisite users' manuals and floppy disk attachments for the Hong Kong Science Hall and Space Hall computer-aided instruction system that has been exported to Hong Kong at a value of 4 billion Hong Kong dollars. There is absolutely no difference between its packaging and standards compared to software commodities imported from foreign countries. This masterpiece of the Xinxin Company has attracted the attention of colleagues in China and foreign countries and the Taiwan Museum signed a CAI manual contract worth 8.5 million New Taiwan Dollars with "Xinxin" in April 1992.

Xinxin Software Industry Company, Ltd., established in 1989, is a joint investment enterprise of the Sichuan Xinchao Computer Group and Hong Kong CIM Company. Over 95 percent of the 200 employees presently in Xinxin Company have undergraduate degrees and 40 percent of them have Ph.D. and Masters' degrees. They have already invested over 60 man/years of technical forces in multimedia software development. They have over 100 terminals connected via a Novell network and achieved real-time data communications in China for the first time and have connected to networks in Hong Kong, the United States, and Singapore.

The multimedia software commodities that have just appeared in the international software market during the 1990's and China's software S&T field are now organizing a multimedia software scientific research project for attacks on key problems during the Eighth 5-Year Plan. Xinxin Company has already turned some of the items into commercial products and has exported them to Hong Kong and other regions and countries, earning over $2 million in foreign exchange. What question does this explain? Is it possible that it only explains the success of the Xinxin Company software industry itself? Certainly not.

In my opinion, doesn't this explain that "5-Year Plans" have a planning schedule that is too long for the development of constantly changing computer technology? This is true. The longest market lifespan for computer products is 2 years and the shortest is one-half year. "5-Year Plans" obviously are no longer synchronized with this quick rhythm.

[Part II No 20, 20 May 92 p 2]

[Text] Wanguo Software Development (Shenzhen) Company, Ltd., has a total investment of $2.2 million. It is a software enterprise established by a joint investment by three parties—IBM Hong Kong Company, Shenzhen University, and Hong Kong East Asian Bank. It is located in a classroom building at Shenzhen University.

Since its opening on 22 June 1991, Wanguo Company has earned $200,000 in foreign exchange from its software exports and its export volume may surpass $2 million in 1992. Wanguo Company now has installed 70 large, medium-sized, and small IBM computers, minicomputers, and workstations. It can truly be said to have a "full complement of IBM hardware" ranging from the IBM4381 and AS/400 to RS/6000 workstations, PS/55, PC/AT, and so on.

Professor Zhu Mingxue [2612 7686 1331] of Wanguo Company stated that "Wanguo" has 86 employees and three levels of products. One is various types of language translation software developed for IBM computers. The second is software replacement products developed for China's banking system. The third level is Wanguo Company's urgent scientific research tasks concerning computers in China. After commercializing large numbers of software scientific research achievements in China, they are loaded into IBM computer hardware and enter world sales avenues for IBM computers.

Everyone knows that many institutions of higher education and software scientific research units in China successfully develop large amounts of high- level tool support software and applied software each year. Because China's software market has not yet developed to maturity and due to the problems with the capital, market sales avenues, and other objective factors required for commercialization of software achievements, these software scientific research achievements on which we have spent large amounts of the state's capital, manpower, and materials have remained on the shelf.

For the past several years, calls to "commercialize software achievements" have risen in succession in computer circles. China's software S&T levels have risen every year and the quality and standards of our software have gradually improved. It is simply that the problem of commercializing software achievements has not been solved.

In June 1991, promulgation of the "Computer Software Protection Regulations" provided more detailed and more concrete support for commercialization of software achievements. There are still many problems, however, in finding the capital and the market sales channels needed for commercialization of software achievements.

Wanguo Company's method is undoubtedly a bold attempt. Of course, a great deal of work is required for commercializing China's software scientific research achievements into computer hardware support products in foreign countries, but even if it was more complicated, it would still be easier than starting from the beginning to design our own software achievements.

I heard general manager Deng Aiguo [6772 1947 0948] of Shenzhen's Dahua Computer Software Company give an optimistic forecast of their company's prospects. He said that the value of output from Huada software alone during the next 2 years will be more than 100 million yuan renminbi.

Established in December 1983, Huada Computer Software Company has earned profits of more than 1 million yuan renminbi a year during the past 9 years, and it exported instructional software to Singapore worth $680,000 in 1991. In October 1989, Singapore senior minister Li Kuan Yew personally observed the installation of Singapore's

software at Huada. The "Huada Chinese Language Software Package" now accounts for more than 40 percent of the Chinese software market in Singapore and Malaysia.

As chairman of the Shenzhen Software Industry Association, where does Deng Aiguo's confidence in his company's prospects come from? Apparently, Singapore Harbor now plans to adopt automated management and automated dispatching systems and the thousands of freighters that pass through Singapore Harbor will all have to be outfitted with this system. "Huada" is now pursuing cooperation with Singapore in this area and if the cooperation is successful, Deng Aiguo's estimate of his company's future earnings may be a conservative figure.

Now, the 1,400 square meters of area that Huada is using is obviously not sufficient. As its business has developed, Huada Company is now preparing to increase the area used by its personnel.

Just when I was feeling that there were too many things for my eyes to take in regarding the achievements of Shenzhen's export-oriented software enterprises, I heard an intense cry at Dalong Electronics Company, Ltd.: we must not abandon the domestic system integration software market!

Established in 1984, Shenzhen Dalong Electronics Company, Ltd. is a limited stock company joint investment enterprise with IBM's Hong Kong agent, Siwei Computer Systems Company, Ltd., and it is an economic entity under the jurisdiction of the Shenzhen Saige Group. Of its 60 employees at present, 92 percent are engineering and technical personnel, including 12 doctorates and post-doctorates, six senior engineers, and eight with Masters' degrees. Starting in August 1987, "Dalong" has provided over 100 system integration software sets (items) for China's computer applications market. Its income from sales in 1991 reached 17 million yuan renminbi, and it won bids worth $500,000 in international bidding. It has provided Xinjiang's Tabei [Northern Tarim] Oil Field with the first set of desert oil field process control and unattended systems in China.

"Dalong's" DL-9000 distributed control system is suitable for controlling pressure, temperature, flow rates, liquid levels, analysis, concentration, temperature, and other production processes. With 1 yuan renminbi, this system can replace $1 dollar in imported systems. This system is now being used by Shanghai Gaoqiao Oil Refinery, Jiangxi Jiulong Oil Refinery, and Beijing Yanshan Chemical Plant and has conserved large amounts of foreign exchange for the state.

In addition, "Dalong" has also provided the first IBM AS/400 D60 high-grade applications software system in China at a value of $1.2 million for Shenzhen City's social and people's labor insurance system. It has also provided applications software systems for two AS/400 D35X and three AS/400 D40 parallel medium-sized computers for the Ping'an Insurance Company.

Elegant Ms. Meng Xianqiu [1322 2009 4428] is general manager at "Dalong". She told me that the development and product directions of China's software industry must be oriented toward both the domestic and foreign markets. Otherwise, China's high-grade software technology, products, and skilled personnel will be sold cheaply on the international market and a blank will appear in our domestic computer applications market, and our domestic computer applications market will lag further and further behind the developed foreign countries.

[Part III No 21, 27 May 92 p 2]

"Dalong" general manager Meng's statement aroused my sympathy. Certainly, if on the one hand we sell our high-grade technology, products, and skilled personnel cheaply on the international market and on the other hand purchase system integration software at high prices from foreign countries for which there is a blank or an urgent need in China's computer applications market, and if this software is something that we can design and complete ourselves, what is the significance of exporting to earn foreign exchange?

China is a nation with backward traditional industry and an integral national economic system. Given this situation at present, it is not very possible that China can use some new emerging industries to replace our traditional and integral industry system completely before the mid-21st Century. We can only use advanced electronics industry system products centered on computers to upgrade traditional industry.

At present, while China's computer hardware has no advantages in quality, speed in supplying products, and interfacing with instruments and gauges, Chinese software does have price and skilled personnel advantages, especially system integration software like the Dalong Company's. The question of how to make use of these advantages and organize these advantages to guarantee technical upgrading in enterprises, especially medium-sized and small enterprises, is a market for the software industry at the present time that cannot be ignored.

Today, against the background of China's planned commodity economy, how to divide China's computer industry into an export foreign exchange earning type, domestic market type, and other different development levels and rationally formulate proportions for domestic and foreign market technology and industry forces may be a good thing that falls within the scope of industry administrative department planning.

The southern China production base area of Great Wall Computer Group is located in Shenzhen's Bagualing Industry Zone. Besides its mainframe, monitor, printer, and label plants and computer case plant, Great Wall Group also has a Software Engineering Department located in Shenzhen. Great Wall Software Engineering Department manager Chen Lianghua [7115 5328 5478] is a doctoral student who graduated from Beijing University in 1989. I learned that starting in April 1992, the 20-plus subsidiary companies, independent investment companies, and so on under Great Wall Computer Group must all implement "simulated legal person" management. This

is also true for Shenzhen's Great Wall Software Engineering Department, which is a full illustration of the Great Wall Computer Group's concern for development of the software industry.

To date, Great Wall Computer Group is the company with the strongest software technology forces among state-run computer group companies. Its Southern and Northern Software Engineering Departments now have over 150 employees. Great Wall Company's software development is divided into five levels: 1) Great Wall applications system structure. This is a system structure that developed in parallel with the ACE (Advanced Computing Environment) International Group, and it also includes hardware platforms. This system structure is not just a conceptual and design idea, but is instead actual hardware and software system products. 2) Peripheral-related drive programs written in assembly language. 3) A new generation Great Wall Chinese language word processing environment, including an input method abbreviated as "ABC". 4) A structured operating system and operating environment system software interface. 5) An applied support system, work processing, form processing, composition and printing, CAD, graphics/image processing, and so on. In addition, it also includes an applications system containing banking applications software, and so on.

After implementation of the "Computer Software Copyright Registration Methods" announced by China in April 1992, the pace of software commercialization at Great Wall was increased and extended toward Chinese-made non-Great Wall computers. Chief engineer Lu Ming [4151 2494] told me that the advantage of commercializing Great Wall's software lies in using Great Wall hardware as a carrier to sell the same system as a software and hardware product. For both the software and the hardware, the Great Wall sales network ensures that sales channels are kept open.

In just 1 week, I only went to six or seven units, which was like viewing the flowers from horseback and there are many intensive and moving aspects that have still not been exploited, but there was enough to make me feel inspired. Of course, I discovered during my visit that Shenzhen's software industry has encountered many problems in its development including common problems, the first of which is that export licenses issued by China's foreign trade departments are effective for only 3 months. This has especially irritated hardware independent investment companies. DEC Shenzhen Hardware Company general manager Zhang Jinlun [1728 6855 0243] said worriedly, I don't understand why mainland China requires the issuance of export licenses. Wasn't mainland China encouraging exports of foreign business and foreign investor products? I see that my export license will expire on 1 May 1992 and the next group of licenses have not been issued yet, so I may lose some of my international market. Note that while this problem exists in hardware independent investment plants and businesses, it will affect investments by foreign investors in the software area.

Second, it is hard for personnel in software joint investment enterprises to leave China. After software commodities are exported, providing excellent, immediate, and comprehensive service to users is the basic reputation of a company's software products and the professional ethics of a software company, but Shenzhen's software development personnel must wait 1 or 2 months to leave China, which is hard for users in foreign countries to accept and many cause the loss of many software export opportunities.

There are many other similar problems that exist within and outside of Shenzhen's software industry, but problems are problems and development is development. While gradually resolving problems, a plan to "build nests to attract birds" by establishing software base areas was implemented in 1992 between the Shekou and Shangbu regions, and a large portion of software forces from the interior of China have moved to Shenzhen.

If all of China's software forces in institutions of higher education could be like Wuhan University and enter into Dashen Data Processing Company and cooperate successfully with hundreds of data companies in Japan;

If the technical content of all our software products could be like Xinxin Software Company Ltd. and be welcomed by users in the international market;

If our system integration software could be like Dalong Electronics Company Ltd. and attack the domestic applications market...

If...

Then what would China's software industry be like! I believe readers will certainly find an answer to the question posed in the title of this article.

Optical Neural Network With Second-Order Interconnection

92P60419C Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 19 No 6, Jun 92 pp 455-458

[Article by Lin Senmao [2651 2773 5399] of the Department of Electronic Engineering, Xiamen University, and Wu Jie [0124 2638] and Liu Liren [0491 4539 0086] of the CAS Shanghai Institute of Optics and Fine Mechanics: "Optical Neural Network With Second-Order Interconnection"; MS received 30 Mar 90, revised 24 Jul 90]

[Abstract] Based on Jang's use of a holographic outer-product system to implement a second-order neural network, the authors propose a polarization encoding method using a single unipolarized mask representing a bipolarized interconnection matrix. A second-order-interconnection optical neural network is implemented with two types of noncoherent optoelectronic systems, as shown in Figures 1-4 below (SLM = spatial light modulator). Figures 5 and 6 (not reproduced) show numerical simulations of the quadratic associative memory and experimental results, respectively.

References

J. S. Jang et al., OPT. LETT., 13, 693 (1988).

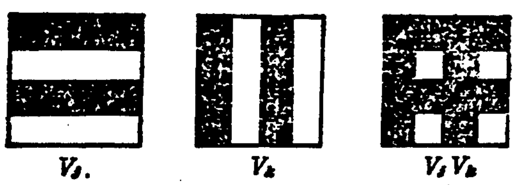


Figure 1. Construction of 2-D Input Matrix $v_j v_k$ by Overlapping Two Identical 1-D SLMs Orthogonally

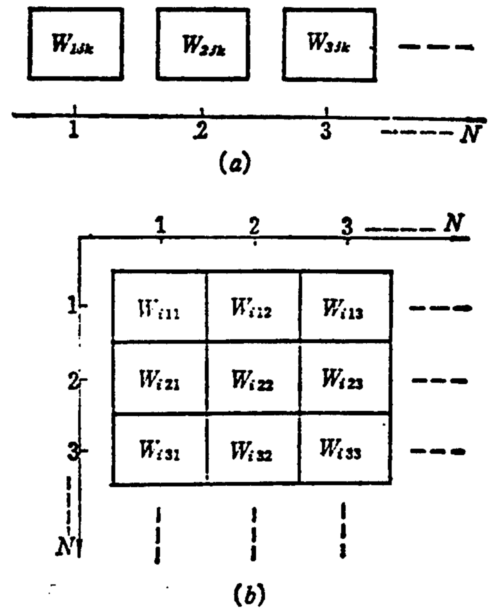


Figure 2. Optical Scheme Representing a 3-D Memory Interconnection W_{ijk} With a 2-D Mask—(a) i matrix blocks of W_{ijk}; (b) j x k matrix cells in each block

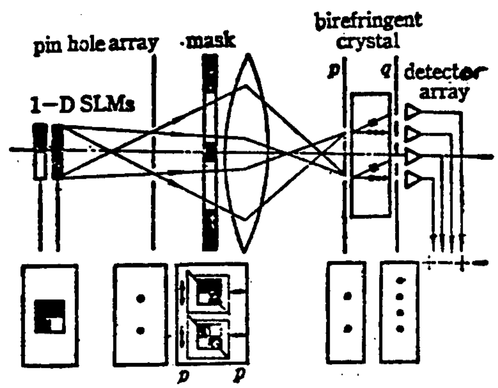


Figure 3. The Quadratic Associative Memory Based on a Multiple-Imaging System (electronic part is omitted)

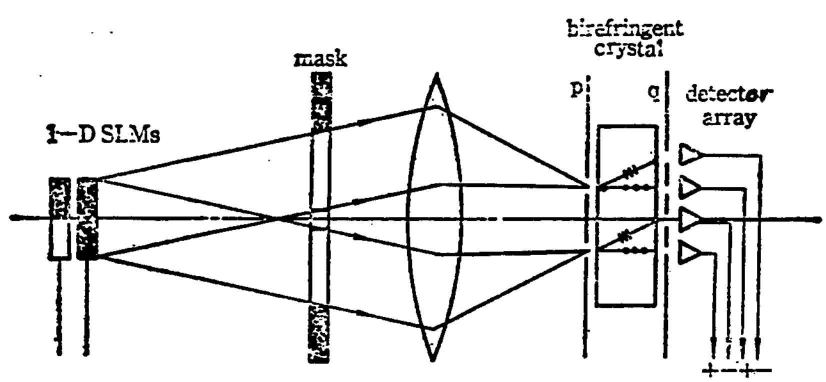


Figure 4. The Quadratic Associative Memory Based on a Correlation System (electronic part is omitted)

Fabrication, Characterization of $Nd:MgO:LiNbO_3$ Waveguides

92P60419D Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 19 No 6, Jun 92 pp 470-472

[Article by Zhang Changyi [4545 2490 1150] and Qiu Yuanwu [6726 0337 2976] of the Pohl Institute, Tongji University, Shanghai, and Su Chunli [5685 2504 7787] and Xu Zhengquan [6079 2398 2938] of the Physics Department, Shanghai Jiaotong University: "Fabrication, Characterization of $Nd:MgO:LiNbO_3$ Waveguides"; MS received 9 Aug 91, revised 1 Nov 91. Project supported by grant from NSFC.]

[Abstract] $Nd:MgO:LiNbO_3$ waveguides have been fabricated by the proton exchange (PE) method, with benzoic acid as the PE source (exchange time = 1.5-4.5 hours, exchange temperature = 230-248°C). Via prism coupling, the effective refractive indices of the waveguides were measured to obtain effective index profiles and diffusion coefficients. Infrared (IR) absorption spectra of the waveguides have been measured. Results indicate that the properties of the waveguides are similar to those of $MgO:LiNbO_3$ waveguides fabricated by PE. Figures 1-6 (not reproduced) show the effective refractive index profile of x-cut Nd-doped waveguides, plots of depth vs sqrt time for Nd-doped PE waveguides at 230 and 248°C, plots of depth vs sqrt time for x-cut and z-cut Nd-doped PE waveguides, IR absorption spectra for z-cut Nd-doped waveguide, IR absorption spectra for x-cut Nd-doped waveguide, and IR absorption spectra for x-cut non-Nd-doped waveguide, respectively.

References: 6 English.

GaAs/GaAlAs Window Buried Heterostructure Laser

92P60419A Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 19 No 6, Jun 92 pp 406-410

[Article by Gao Wei [7559 0251] of the Physics Department, Beijing University, Zhuang Wanru [8369 1238 1172] of the CAS Institute of Semiconductors, and Tan Shuming [6223 0647 2494] of the Physics Department, Northern Jiaotong University, Beijing: "GaAs/GaAlAs Transmission-Window-Type Buried Heterostructure Laser Diode"; MS received 3 Apr 90, revised 18 Jun 90. Project supported by grant from NSFC.]

[Abstract] Based on analyses of coupled laser rate equations, three essential ways for extending the bandwidth of a semiconductor laser are presented. Also given are the design, fabrication techniques, and characteristics of a GaAs/GaAlAs window buried heterostructure (BH) laser diode, an optoelectronic device providing high-speed direct modulation in many areas, such as ultra-high-capacity fiber optic communications, high-bit-rate information processing, ultra-short-pulse signal acquisition and transmission, and OEICs.

The GaAs/GaAlAs window BH laser diode, shown schematically in Figure 1 below, was fabricated via a two-step LPE technique. Room-temperature measurement of the laser diode in CW operation shows a threshold current of 29 mA and a maximum linear output power of 15 mW, while measurement at 90°C (the maximum emission temperature) shows a threshold current of about 52 mA and a maximum linear output power of about 4 mW. At 50 mA, the laser diode has an operating wavelength of 827.5 nm and a FWHM of 0.03 nm; side-mode suppression ratio is 14 dB. Figures 2-4 (not reproduced) show graphs of optical cavity loss, light vs current characteristics of a sample laser diode at various temperatures, and the spectrum of the sample laser diode.

References: 10 English, 2 Chinese.

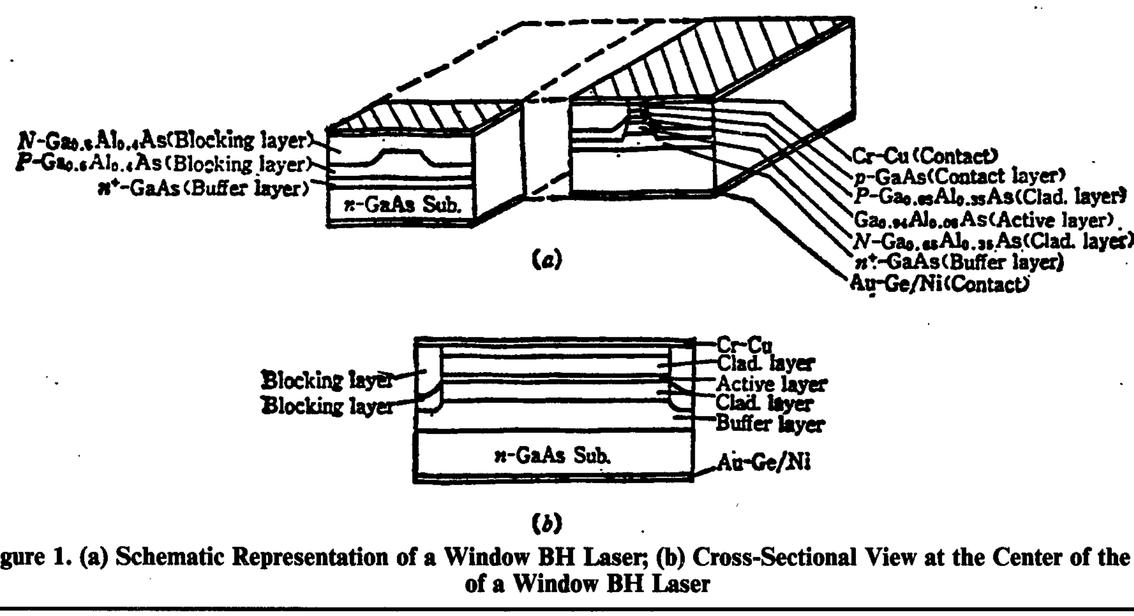


Figure 1. (a) Schematic Representation of a Window BH Laser; (b) Cross-Sectional View at the Center of the Mesa of a Window BH Laser

CW Output Power From Domestic Ti:Sapphire Laser Exceeds 1W

92P60419B Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 19 No 6, Jun 92 p 447

[Brief letter by Deng Peizhen [6772 3805 3791], Qiao Jingwen [0829 2529 2429], et al. of the 8th Laboratory, CAS Shanghai Institute of Optics and Fine Mechanics, and Liu Yupu [0491 3768 3877], Zhang Yinghua [1728 1758 5478], and Lu Peihua [7120 1014 5478] of the Laser Technology Open Laboratory: "Ti:Sapphire Laser Continuous-Wave Output Power Exceeds 1 Watt"; MS received 10 Mar 92]

[Summary] Using our independently developed induced-thermal-field up-shift (IFUS) technique for growing Ti:sapphire crystal, we have perfected a CW Ti:sapphire laser with a maximum output power of 1.25 W, a threshold power of under 1.0 W, an overall conversion efficiency of 12.5 percent, and a slope efficiency of 15 percent. This Ti:sapphire laser is pumped by a domestically made A-240 Ar-ion laser (wavelength: 488 nm, 514 nm, full-line). The $Ti{:}Al_2O_3$ laser crystal rod has dimensions of 3.5 mm x 3.5 mm x 15 mm and its α_{490} value is 2.0 cm^{-1}.

Features on Domestic Sensor R&D

Sensors for Space Engineering

92FE0616A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 20, 20 May 92 p 75

[Article by Song Zongyan [1345 1350 3508] of the Institute of Telemetry Technology, Ministry of Aerospace Industry: "Present State, Future Development of Sensors for Space Engineering"]

[Excerpts] Sensors are used in a wide variety of aerospace applications. For example, they are used extensively in wind-tunnel tests of aircraft models, engine tests, static strength tests as well as in flight tests. In particular, the most sophisticated and the largest number of sensors are used for remote sensing during flight tests. In this article, the remote sensors used in space applications are discussed.

I. Applications of Remote Sensors in Space Engineering

China has had a history of over 30 years in developing remote sensors for space applications; it has developed more than 500 sensors and signal regulators to perform in-flight and ground-based remote sensing tasks for satellites and launch vehicles. Their applications are concentrated in the following areas:

1. Monitoring of the operating conditions of spacecraft components and subsystems, design verification, and data collection.

2. Monitoring of spacecraft attitude, position, acceleration and velocity and transmission of the information to the ground for spacecraft control.

3. Control of the environment inside the spaceplane or spaceship, monitoring of the parameters of astronaut's life-preservation system, and collection of scientific data of outer space such as space particles and magnetic field, etc.

The first-generation space sensors were resistor-type sensors (potentiometer, etc.) designed to measure such parameters as pressure, load, angular velocity, angular displacement, speed of rotation, relative displacement and temperature. In the late 1960's, signal regulator circuits were too bulky to be used for flight tests because most of their components were made of electron tubes.

Potentiometer-type sensors provided strong signals without having to use signal regulator circuits. They were developed based on the technical foundation of autopilots used on aircraft and industrial process-automation instruments; therefore, they had the technical maturity for small-scale production. Based on the state of China's industrial capabilities at that time, only this type of sensor could satisfy the needs of the first-generation space sensors. The development of such sensors involved mainly imitations or design modifications of foreign products. However, through the development of these first-generation sensors, China was able to perform the tasks of remote sensing for flight tests of its early spacecraft; it also built up a team of designers and engineers of space sensors and established an industrial base for developing future remote sensors. The first-generation remote sensors were typically mechanical devices containing many transmission mechanisms and moving parts; they were unreliable under adverse dynamic conditions and were subject to large errors caused by the transmission mechanisms and friction. As a result, the accuracy of these sensors was quite low (in the range of 1.5-2.0 percent), and the measured parameters were limited to mechanical, thermal parameters or motion and position parameters (liquid level, relative displacement, etc.).

During the 1960's and 1970's, the development of long-range liquid-propellant rockets, solid-propellant rockets and satellites imposed increasing demands not only on the types and quantities of remote sensors, but also on their accuracy (0.5-1.0 percent); in addition, requirements were also imposed on the sensors to operate reliably under adverse dynamic environments (e.g., vibration, shock, extreme temperatures) over extended periods. During this period, a technically mature design team had evolved and specialized laboratories had been built; China had entered a stage of designing and building its own space sensors. A significant number of highly reliable and accurate (0.5-1.0 percent) sensors with field-effect components (e.g., inductors, capacitors) and transistorized signal regulators were developed, and were successfully used on a variety of different spacecraft. At the same time, as a result of the increasing level of technical exchanges with foreign countries, considerable attention was given to research and development of miniature solid-state sensor technology; in the early 1970's, efforts were initiated to build research laboratories to study piezoelectric sensor devices. Unfortunately, because of the problems associated with temperature effects and stability of these sensors, they could not be used directly on spacecraft remote sensing systems.

II. Development Strategy of Space Sensors During the Seventh 5-Year Plan and Eighth 5-Year Plan

With the proposed plan to build large, long-range rockets, solid-propellant tactical rockets, satellites and space shuttles, higher demands were placed on space sensors and new requirements were imposed on sensor quality. Because the second-generation sensor technology could no longer meet these requirements, efforts were initiated to develop a strategy and to establish general guidelines for future development of space sensors. A basic development plan for the next 10-year period was proposed on the basis of China's financial resources and technical capabilities. Specifically, highlights of the plan include:

- Emphasize design versatility to meet the requirements of future space vehicles; broaden the scope of research and development;
- Improve compatibility with space-vehicle design in terms of size and weight, environmental adaptability, electromagnetic tolerance and data exchange;
- Improve accuracy and reliability in order to satisfy different remote-sensing and control requirements as well as storage and calibration requirements;
- Establish standardized and serialized designs to provide better compatibility with spacecraft remote-sensing systems;
- Develop automated inspection and test capabilities such as self-diagnostics, self-correction, data communication and programmable testing procedure.

III. Recent Development of Space Sensors

Since 1988, China has taken the following measures toward improving its space sensor technology:

1. Conduct a comprehensive review of China's space sensor development over the past 30 years, initiate studies of sensor development strategy based on projected development of future space-vehicle models, and determine the direction, critical areas and methodology of sensor research for the next 10 years. [passage omitted]

2. Sponsor applied and basic research projects in coordination with spacecraft development needs. [passage omitted]

3. Establish a national laboratory and test center as the research base for space sensor technology. This project has already been approved by the state and the design of a building for the laboratory and test center is under way.

Fiber Optic Sensors in General

92FE0616B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 20, 20 May 92 p 85

[Article by Que Wenxiu [7067 2429 0208] and Zhang Fuxue [1728 4395 1331]: "Present State, Trends in Domestic Development of Fiber Optic Sensors"]

[Text] **I. Introduction**

Fiber optic technology is a relatively new technology that first appeared in the mid-1970's. It is considered to be a major breakthrough in sensor technology because it uses light instead of electricity as the carrier of information and uses optical fibers instead of metallic cables for transmission of information. It has many advantages which are unique to optical measurement and fiber optic transmission such as high sensitivity, electrical insulation, resistance against electromagnetic interference, chemical stability, safety, high information capacity, and ease of implementation in long-range multi-channel measurement and control systems. Consequently, it has received a great deal of attention in the United States, Japan and the Western European countries; in the United States and Japan, the technology has quickly found its way into many practical applications.

In China, research in fiber optic sensor technology began in the early 1980's. In June 1983, the first national planning conference on fiber-optic sensors was held in Hangzhou; in the same year, the State Science Commission sponsored a seminar on fiber optic sensors and their applications. In 1985, a planning conference on fiber optic sensor development during the Seventh 5-Year Plan was held, and a "fiber optic sensor technology coordination group" was formed in Nanjing. These activities provided the stimulus during the early stage of fiber optic sensor development in this country. In recent years, a number of technical conferences on fiber optic sensor technology have been held and more than a hundred technical papers have been presented. Today, this technology has been applied in many areas including national defense, electric power, metallurgy, petroleum and chemical engineering, transportation, scientific research, instrumentation, consumer products, medicine and health care, but most of these applications are still in the experimental stage.

II. Functional and Non-Functional Fiber Optic Sensors

There are two types of fiber optic sensors: functional and non-functional. The so-called functional fiber optic sensor is one where the optical fiber not only serves as a medium for light propagation, but also responds to changes in the environment; its basic feature is that the light signal is modulated inside the fiber to provide higher sensitivity. The so-called non-functional fiber optic sensor is primarily used for light propagation; the sensing elements are made of non-optical-fiber materials, and the light signal is modulated outside the fiber. This type of fiber optic sensor is superior in terms of cost-effectiveness and ease of implementation because it can make use of existing sensing elements and sensing technologies and has the inherent properties of electrical insulation and resistance against electromagnetic interference.

Most fiber optic sensors developed in this country are temperature sensors. For example, the sensor which uses fiber optic sapphire black-body-cavity heads covers a temperature range of 600°-2,000°C, and has an accuracy of +/-0.5°C and a response time of several seconds. The microcomputer-controlled FOS-T1 temperature sensor is made of GaAs material whose absorption spectrum varies with temperature; it covers a temperature range of 0°-200°C with a sensitivity of 0.1°C, and has an accuracy of 2°C and a response time of 2 seconds. The CW-CQ-I temperature sensor covers a temperature range of 650°-1,200°C and has

a measurement accuracy of +/- 1 percent and a response time of 1 second. The single-filament, flexible high-temperature sensor covers a temperature range of 700°-1,800°C and has a response time of 150 milliseconds. The temperature sensor made with 0.1M cobalt solution has an accuracy of +/- 0.2°C in the temperature range 30°-50°C; it can be used for temperature measurement and control in microwave cancer treatment without disturbing the microwave field distribution. The temperature sensor designed for power equipment covers a temperature range of -30° to +90°C with an accuracy of 1 percent.

The fiber optic displacement meter can measure a maximum displacement of 50 mm with an accuracy of 0.2 mm at a distance of 100 m. The micro-displacement sensor with a sensitivity of 0.1 micron can be used to measure submicron-level vibrations. The fiber optic chemical sensor can be used for analyzing biological quantities such as glucose, Na, K and O_2 partial pressure. The dual-wavelength fiber-optic lightmeter has measurement range of 10^{-1}-10^{-6} M with an accuracy of 1.7 percent, which is superior to that of many foreign products of similar design. The multi-function fiber optic acoustic sensor has a sensitivity of -169 to +155 dB, and the acoustic gain per unit length is 0.6-2 dB. The new birefringent fiber optic pressure sensor has a pressure-temperature ratio of 53 $Kbar^{-1}$; its pressure sensitivity is nearly unaffected by surrounding temperature variations.

The GGY-1 high-temperature pressure sensor has a range of 0-0.3 MPa; equipped with a small cooling unit, it can be used to measure the dynamic pressure of high-temperature gas at 1,300°C; without cooling, it can measure the fluid pressure at 200°C. The interferometric fiber optic acoustic sensor uses a 5-m-long fiber to provide a detection threshold of 200 μPa; it is more sensitive than the TS-1 precision sensor. The methane fiber-optic sensor can measure a methane concentration level of 1 percent in the environment. The fiber optic field sensor can measure an electric field in space with an accuracy of +/- 2 percent; the passive field sensor has a sensitivity of 12.5 kV/m and an accuracy of better than 2 percent. The fiber optic voltage sensor has a measurement range of 0-1,500 V with an accuracy of 0.5 percent.

The fiber optic liquid-level sensor can operate for long periods under adverse conditions. The prototype fiber optic current sensor developed by Qinghua University has a measurement accuracy of 0-2,500 A with an accuracy of 0.5 percent and a signal-to-noise ratio greater than 80 dB; the unit was certified in 1985. The OSW-1 fiber optic wind gauge and anemoscope, the liquid leakage sensor and concentration sensor, and the OST-1 fiber optic thermometer developed by MMEI's Institute 8 all have comparable performance to that of Japanese products. The fiber optic electric-current and magnetic-field sensor and the fiber-optic titrimeter developed by the Shanghai Institute of Metallurgy of the Chinese Academy of Sciences have also been certified.

In recent years, fiber optic sensors developed in this country are being used in many practical applications. For example, the fiber optic temperature sensor developed by the Chengdu Institute of Radio Engineering has been installed on the Longyang Gorge 320-MW generator for field measurement of temperature rise in large power equipment. The fiber optic single-filament flexible high-temperature sensor developed by the Beijing Steel Institute has been field-tested at more than 20 steel plants; its reliable performance makes it well suited for making non-contact temperature measurements. The successful development of this sensor provides the means for making continuous temperature measurement of liquid iron and for implementing computer control in steel production. In addition, the CW-CQ-I fiber optic thermometer has been successfully field-tested for the high-frequency quenching process at the Nanjing Processing and Assembly Plant. The fiber optic impulse-voltage temperature measurement system has been delivered for use by the Ministry of Aerospace Industry.

The above discussion indicates that while research in fiber optic sensor technology is very active in this country and encouraging results have been obtained in the applications area, most work is still in the exploratory and development stage. It is predicted that during the Eighth 5-Year Plan, a large market will be created for fiber optic temperature sensors to be used in large power plants, chemical plants and metallurgical factories. Fiber optic sensors will also be used for current and voltage measurements in high-voltage transformer stations and large generator plants; in addition, there will be an increasing number of fiber optic sensors used for measurement of pressure, displacement and liquid level, and for military and defense applications.

III. Distributed Fiber Optic Sensor Systems

In engineering and scientific experiments, many field parameters such as temperature field, pressure field, stress field, strain field, velocity field, electric field, magnetic field, sound field, concentration field, density field and component field must be measured. In order to measure the spatial distribution and time variation of the above parameters, data must be taken by many widely-spaced point sensors to provide a composite description of the field distribution. However, such a measurement process is very complicated and costly, particularly in an environment where flammable or explosive materials or strong magnetic interference are present, or where the dimensions of the field of interest are very large, or where the sensors must be embedded so as not to alter the field characteristics. In these situations, the distributed fiber optic sensor will play a specially important role.

A distributed fiber optic sensor is a device which can make measurements along a selected path by assigning the measured direction as a function of position along the length of the fiber. Thus, by distributing the fibers over the field and using special detection techniques, it is possible to measure and monitor the spatial distribution and time variation of the field data. This type of sensor requires only one light source and one detection circuit, and has an integrated design which combines the sensing and propagation functions in a single unit. Because of its telemetry and monitoring capability and its high performance-to-price ratio, it is capable of competing with any point sensor. For this reason, it has received considerable attention in recent years.

Chongqing University has been engaged in research on distributed fiber optic temperature sensor technology and pressure sensor technology under the support of the State Education Commission. In particular, the university has developed a distributed fiber optic temperature sensor system which uses all domestically made parts and is capable of measuring temperature distribution within a range of 1,000 m. The system has a temperature resolution of 6°C and a position resolution of 4 cm.

Although the distributed fiber optic sensor has great potential in a wide range of applications, its practical use depends on solving the following problems: improving its sensitivity, increasing its dynamic range, reducing its response time, and enhancing its spatial resolution and measurement accuracy.

IV. Development Trend of Fiber Optic Sensor Technology

Currently, some of the non-functional fiber optic sensors and a small number of functional sensors are used in practice. But most fiber optic sensors are in the development stage and a few high-performance sensors and sensor systems are still in the verification stage.

The main problems with fiber optic sensors are stability, reliability and price. Based on current technology, improving stability and reliability will not be too difficult, but because of the high cost of the light source, the optical detector and other optical components, the price of fiber optic sensors is not likely to drop significantly within the next 10 years. But with the development of fiber optic communications and laser technology, by the beginning of the 21st century, high-quality fiber optic sensors will be available at a reasonable price.

In the foreseeable future, the fiber optic sensor market is still dominated by military products such as fiber optic gyroscopes, fiber optic sonar systems and other multi-function fiber optic sensor systems. However, significant progress will also be made in commercial applications such as medicine and health care, chemical engineering, electric power, robotics, and telemetry and remote control. In these areas, the traditional electric sensors will likely be replaced by fiber optic sensors.

Although the fiber optic sensor has already demonstrated many of its unique features, it is still being challenged by traditional sensors and other types of new sensors. In order for the fiber optic sensor to be competitive, it is necessary to further improve its performance and reduce its cost, and to develop sensor systems that can take full advantage of the unique features of fiber optic sensors. Therefore, the development trend of fiber optic sensors may be focused in the following areas: integrated fiber optic sensors, multi-function fiber optic sensor systems, low-power-consumption remote monitoring systems (e.g., systems for environmental pollution monitoring, coal-mine gas monitoring, nuclear power plant safety monitoring, and nuclear explosion monitoring). The development of distributed fiber optic sensors will be focused in the areas of fabrication of optical fibers, signal detection and new applications.

Fast Optical Bistability in Multiple Waveguide Coated With Copper Phthalocyanine LB Films

40100074A Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 12 No 6, Jun 92 pp 562-564

[English abstract of article by Fan Junqing, Li Yajun, et al. of the Changchun Institute of Physics, CAS, Changchun, 130021; MS received 20 May 91, revised 12 Nov 91]

[Text] Thirty-four layers of tapCuPc, copper tera-4-(2.4-ditert-ampylphenoxy) phthalocyanine, were deposited by the LB [Langmuir-Blodgett] technique on an optical glass waveguide of K^+ ion-exchange, and a four-layer dielectric waveguide with LB films cladding is formed. The 532 nm line from a YAG laser is used as a light source. The input light with pulse width of 250 ps is coupled into the optical waveguide by a glass prism, and then is passed through the region coated with the LB films. In the experiment, fast optical bistability with switching off time to 24 ps has been demonstrated.

Optical Parametric Generation With High Conversion Efficiency

40100074B Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 12 No 6, Jun 92 pp 575-576

[English abstract of article by Zhao Qingchun, Lu Yutian, and He Huijuan of the Lab. of Laser Technology, Shanghai Institute of Optics and Fine Mechanics, CAS, Shanghai 201800 and Liu Yaogang and Wang Jiyang of the Institute of Crystal Materials, Shandong University, Jinan 250100, China; MS received 4 Dec 91, delivered at CLEO'92]

[Text] Using a 6.5 x 9 x 20 (length) mm KTP [potassium titanyl phosphate] crystal, picosecond pulses were obtained with tunable range of 625 nm-3,575 nm, maximum energy conversion efficiency of 30 percent, and maximum peak power of 34 MW.

Experimental Studies of NYAB Green Laser Pumped by Xenon Lamp

40100073A Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 19 No 6, Jun 92 pp 401-405

[English abstract of article by Huang Yichuan, Qiu Minwang, et al. of the Fujian Institute of Matter Structure, CAS, Fuzhou; MS received 29 Mar 91, revised 13 Aug 91]

[Text] Results of studies of pulsed green laser output characteristics using self-frequency-doubling laser crystal NYAB [$Nd:YAl_3(BO_3)_4$] grown in our institute are presented. A few mJ laser output at 0.53 μm from a NYAB crystal with a size of φ 3 x 11 mm^3 has been obtained when it was pumped by a xenon flashlamp of φ 3 mm x 25 mm. A repetition rate experiment of NYAB laser with rates of 1-20 Hz has been done. It can be seen from this work that NYAB crystal is a promising material for green miniature lasers.

Table 1. Characteristics of NYAB Crystal

Chemical formula		$Nd_xY_{1-x}Al_3(BO_3)_4$
Stimulated emission cross section of 1.062 μm		1.06×10^{-18} cm^2
Fluorescent lifetime		about 60 μs
Refractive indices	1.062 μm	$n_0 = 1.7613$ $n_e = 1.6886$
	0.531 μm	$n_0 = 1.7820$ $n_e = 1.7064$
Phase matching angle		30°50' (TYPE I) 45°38' (TYPE II)
Effective SHE coefficient		$d_{eff} = 1.30$ pm/V (TYPE I)
Walkoff angle		2°13'
Density		3.75 g/cm^3

Table 2. Green Laser Power Output of LD-Pumped NYAB Crystal Grown in Fujian Institute

Date	Nation and corporation	Operation mode	Laser mode	Input power (mW)	Output power (0.53 μm)	Slope efficiency	Overall efficiency
1989.4	U.S.A. CREOL	CW	multimode		10 μW		
1989 11.15	Germany GWU-L	CW	multimode		10 mW		
1990 1.19	Germany ADLAS	CW	multimode	1700	21 mW		1.24%
1989 12.27	Japan HOYA	CW	multimode	360	16 mW		4.4%
1990 1.25	Japan HOYA	CW	multimode	375	22.7 mW		6.1%
1990 1.25	Japan HOYA	CW	single longitudinal mode	360	3.8 mW		1.1%
1991 1.9	Japan HOYA	CW	multimode	400	70 mW		17.5%
1990 11.20	U.S.A. Lasergenics and P. R. China FIRSM	CW	TEM_{00} mode	335	27 mW		8%
1991 1.17	U.S.A. Lasergenics and P. R. China FIRSM	CW	TEM_{00} mode	370	35 mW	24%	9.5%

Optimum Design, Fabrication of Submicron LDD MOSFET ICs

92P60426A Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 7, Jul 92 pp 423-429

[Article by Yu Shan [0151 1472], Zhang Dingkang [4545 1353 1660], and Huang Chang [7806 2412] of the Shaanxi Microelectronics Research Institute, Lintong, Shaanxi 710600: "Optimized Design, Fabrication of Submicron LDD MOSFET ICs"; MS received 8 Apr 91, revised 14 Nov 91]

[Abstract] The impurity distribution and spacer technology of 0.55-µm-gate-length LDD MOSFET ICs (lightly doped drain metal-oxide-semiconductor field effect transistor integrated circuits) have been studied. Optimized design and fabrication of submicron LDD MOSFET ICs—which are used in a variety of VLSI circuits, including 64 Mbit DRAMs—are discussed. First, optimum annealing conditions are found to be 950°C for 30 minutes. Then, source and drain implantation conditions have been found to be: As^{75} 100 keV, 5 x 10^{-15} cm^{-2}. Next, via LPCVD (low-pressure chemical vapor deposition), the SiO_2 spacer (i.e., side wall) LDD structure is fabricated. Finally, optimized LDD N^- implantation conditions have been found to be 1-3 x 10^{13} cm^{-2}, 45 keV. With these conditions, the authors have fabricated 0.55-µm LDD MOSFETs, first reported in 1987 and since improved. Via the optimized technique, the authors have also more recently developed a 0.5-µm CMOS voltage-controlled oscillator with a maximum frequency of 600 MHz, a controllable frequency range of 300 MHz, and a 27-stage ring oscillator gate delay of 200 ps (announced in 1991) and a 1-µm CMOS bus switching logic circuit for a three-mode fault-tolerant system (announced in 1990). Figures 1 and 3, reproduced below, show schematics of the LDD MOSFET cross section and a cross section detailing the three-layer-structure polycrystalline silicon spacer. Figures 2 and 4-8, not reproduced, show graphs of the impurity distribution, breakdown voltage vs gate length, N^- implantation dose and energy under various conditions, and drain-source current vs gate-source voltage.

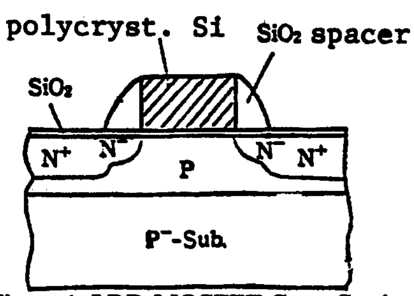


Figure 1. LDD MOSFET Cross Section

References: 6 Chinese, 18 English.

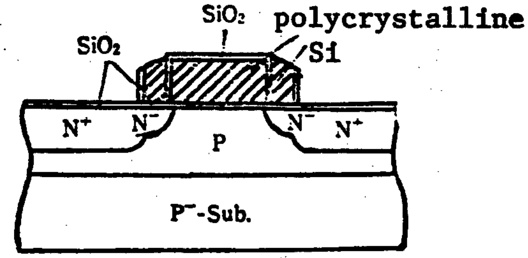


Figure 3. LDD MOSFET Cross Section Detailing 3-Layer-Structure Polycrystalline Si Spacer

Study on Optical Transition Between Subbands of AlAs/GaAs Superlattices by Photovoltaic Spectra

40100078A Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 7, Jul 92 pp 405-410

[English abstract of article by Zhu Wenzhang, Chen Chao, and Lui Shiyi of the Department of Physics, Xiamen University, Jiang Desheng and Zhuang Weihua of the Institute of Semiconductors, CAS; MS received 26 Apr 91, revised 2 Sep 91]

[Text] The photovoltaic spectra (PVS) of AlAs/GaAs superlattices have been taken by capacitor coupling at temperatures ranging from 18K to 300K. Below 100K, the curves of PVS reflect the steplike distribution of two-dimensional state density, and six peaks have been observed. The levels and bandwidths of the subbands in the potential well have been calculated by using the Kronig-Penney model. For the samples used in the experiment, there are three conduction subbands, three light-hole subbands and six heavy-hole subbands. The six peaks are assigned according to the selection rule for optical transition based on the conservation law of parity. The experimental results agree well with the theoretical calculated results.

Super-Shallow Junction Formed by Electron-Beam Doping Boron During Glow Discharge

40100078B Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 7, Jul 92 pp 448-452

[English abstract of article by Li Xiuqiong, Wang Chun, et al. of the Microelectronics Center, CAS, P.O. Box 650, Beijing, 100010; MS received 24 Apr 91, revised 27 Jun 91]

[Text] A new method of semiconductor doping—doping by electron beam—has been successfully used to fabricate boron super-shallow junctions. The semiconductor surface coated with boron sources was irradiated by electron beam produced during glow discharge to form a doping layer with high impurity concentration (> 10^{20} cm^{-3}) and super-shallow junction (< 0.1 µm). The lattice damage is much less serious than that prepared by ion implantation. A solar-sensitive device with excellent performance was successfully fabricated.

Multiphonon Resonant Raman Scattering Study From CdTe/ZnTe Superlattice

40100078C Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 7, Jul 92 pp 453-456

[English abstract of article by Zhang Shulin, Hou Yongtian, et al. of the Department of Physics and National Laboratory for Artificial Microstructure and Mesoscopic Physics, Beijing University, Beijing 100871, Li Jie and Yuan Shixin of the Shanghai Institute of Technical Physics, CAS, Shanghai 200083; MS received 20 Dec 91, revised 6 Jan 92]

[Text] Multiphonon resonant Raman spectra in a CdTe/ZnTe superlattice have been obtained. The results indicate that we have observed for the first time up to 10th-order multiphonon Raman scattering and the phenomena that the transition between subbands in superlattice is involved in the resonant Raman scattering process.

Donor Levels in Te-Doped AlGaAs

40100071A Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 6, Jun 92 pp 327-332

[English abstract of article by Kang Junyong, Huang Qisheng, Lin Hong, and Chen Chao of the Department of Physics, Xiamen University, Xiamen, 361005, and Tang Wenguo and Li Ziyuan of the National Laboratory for Infrared Physics, Shanghai, 200083 (MS received 23 Mar 91, revised 11 Aug 92)]

[Text] Impurity levels in Te-doped Al_xGa_{1-x} As for the composition range $x = 0.23$-0.77 have been studied by photoluminescence and deep-level transient spectroscopy under dark and illuminated conditions. The results show that a complicated level structure consisting of several donor levels is formed by the substitutional Te impurity. A discussion on the results is given.

Study on Photocurrent Spectra of GaAs/AlGaAs Quantum Wells in Electric Field*

40100071B Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 6, Jun 92 pp 333-342

[English abstract of article by Jiang Desheng, Liu Daxin, Zhang Yaohui, Duan Hailong, and Wu Ronghan of the Institute of Semiconductors, CAS, Beijing, 100083 (MS received 11 Mar 91, revised 29 May 91)]

[Text] The quantum-confined Stark effect of GaAs/AlGaAs multiple-quantum-well (MQW) p-i-n diodes are investigated with photocurrent (PC) spectra under electric field at room and low temperatures. The polarization effect of light- and heavy-hole exciton peaks is observed by side-illumination measurements. A comparison of PC and photoluminescence excitation (PLE) spectra indicates that the applied electric field has large influence not only on the optical absorption, but also on the drift processes of the photo-generated carriers in MQWs. The spectral line shape of PC is analysed by a depletion model of p^-/n^+ junction with the consideration of the attenuation of the incident light beam due to absorption transitions. The Stark shift of PC peaks relative to PLE ones gives a clear indication to the distribution of electric field in MQW region and the validity of the depletion model.

* Work supported by National Laboratory of Superlattices and Microstructures.

Photoreflectance Study of Strained-Layer $In_xGa_{1-x}As/GaAs$ Quantum Wells

40100071C Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 6, Jun 92 pp 343-350

[English abstract of article by Pan Shihong, Liu Yi, Zhang Cunzhou, Zhang Guangyin of the National Laboratory of Semiconductor Superlattices, and Department of Physics, Nankai University, Tianjin, 310071 and Feng Wei and Zhou Junming of the Institute of Physics, CAS, Beijing, 100080 (MS received 11 Mar 91, revised 10 May 91)]

[Text] Photoreflectance (PR) measurements have been performed on three strained-layer $In_xGa_{1-x}As/GaAs$ quantum-well (QW) multiple structure samples, each of which contains QWs of 140, 80, 50, 30 and 20 Angstroms in widths. Optical transitions of 11H and 11L corresponding to each of the QWs have been observed in the PR spectra at temperatures of 300K and 77K. The PR data have been analysed with the envelope function method, and the In compositions in the QWs have been estimated. The temperature dependence of the hydrostatic deformation potential constant has been considered in the explanation of the PR data at 300K and 77K. The best agreement between experiments and theoretical calculations is found with conduction band-offsets 0.7 at 300K and 0.66 at 77K.

Electronic Structure and Ground-State Properties of Semiconducting Alloy $(GaAs)_{1-x}Ge_{2x}$

40100071D Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 6, Jun 92 pp 351-358

[English abstract of article by Duan Wenhui, Gu Binglin, and Zhu Jialin of the Department of Physics, Qinghua University, Beijing, 100084 (MS received 22 Mar 91, revised 2 Sep 91)]

[Text] Electronic structure and ground-state properties of semiconducting alloy $(GaAs)_{1-x}$-Ge_{2x} are investigated by the self-consistent LMTO-ASA method in the modified virtual crystal approximation. The order parameter M is introduced according to the model of zincblende-diamond order-disorder phase transition in the alloy system. The results are in good agreement with the experiments and non-self-consistent calculations. It is shown that the effective masses of light and heavy holes are predominantly dependent on the order parameter M. The V-shape dependence of bulk modula and equilibrium lattice constant on the composition x is predicted.

Influence of Elastic Strain and Structural Parameters on Band Structures of InAs/GaAs Strained-Layer Superlattice

40100071E Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 6, Jun 92 pp 359-366

[English abstract of article by Bi Wengang and Li Aizhen of the Shanghai Institute of Metallurgy, CAS, Shanghai, 200050 and National Laboratory for Superlattices and Microstructures, Beijing, 100083 (MS received 9 Apr 91, revised 12 Sep 91)]

[Text] Results concerning the effects of elastic strain and structural parameters on the band structures for InAs/GaAs strained-layer superlattices (SLS's) are presented. By analyzing the influence of the hydrostatic strain and uniaxial strain on the band edges of the host materials, we have determined the band lineups of InAs/GaAs SLS's, and calculated their corresponding sub-band energies using the envelope-function approximation. It is shown that these quantities are dependent not only on the bulk properties of the host materials, but also on the superlattice lattice constant, layer thickness and strain of individual layer, and a quasi-type-II InAs/GaAs superlattice can be obtained by adjusting the ratio of the thickness of InAs to that of GaAs.

Simulation of Characteristics for GaAs IC DCFL Gate and Circuit Design

40100071F Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 6, Jun 92 pp 367-371

[English abstract of article by Wang Qingkang and Shi Changxin of the Institute of Microelectronics Technology, Shanghai Jiaotong University, Shanghai, 200030 (MS received 19 May 91, revised 30 Jul 91)]

[Text] The static and transient characteristics of a GaAs IC three-input DCFL [direct-coupled FET logic] gate have been simulated using Shockley's model of GaAs MESFET's with the resistances of source and drain. The results are shown in the form of oscillographs. The relation of output waveform to different input wave phases has been given. The results given in this paper are useful in the design of GaAs ICs.

Changsha Institute Develops Tl-Based Superconductor With 126K Transition Temperature

92P60418B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 6 Aug 92 p 2

[News brief by Ma Jun [7456 6511]: "New Progress Made in Research on Thallium-Based High Temperature Superconducting Materials"]

[Text] The Ministry of Metallurgical Industry's Changsha Institute of Mining Metallurgy has fabricated a thallium-barium-calcium-copper oxide (TlBaCaCuO) high temperature superconductor. Via testing at the State Superconductivity Laboratory, samples of this TlBaCaCuO superconductor have demonstrated a zero-resistance transition temperature of 126K (-147.2°C). China has thereby become the second nation able to fabricate a Tl-based high temperature superconductor with a critical temperature exceeding 125K (Japan has reported 127K).

Thermistor HTS Infrared Detector Developed by Shanghai Institute

92P60418A Beijing WUXIANDIAN [RADIO] in Chinese No 5, May 92 p 9

[Article by Wang Bingshi [3769 4426 2514]: "Thermal-Sensitive High Temperature Superconducting Infrared Detector"]

[Summary] Using a YBCO superconducting thin film, scientists at the CAS Shanghai Institute of Technical Physics have fabricated a high-performance thermistor-type high-temperature superconducting (HTS) infrared (IR) detector. In the mid-to-far-IR range (wavelength over 20 μm), this detector's performance far exceeds that of liquid-N-cooled or room-temperature IR detectors. At a 3 Hz modulation frequency, the detector has a noise equivalent power (NEP) of 7.4×10^{-9} W/(Hz)$^{1/2}$; at 10 Hz-884 Hz, NEP is $1.5\text{-}2.0 \times 10^{-9}$ W/(Hz)$^{1/2}$. These performance indicators surpass those reported in 1989 by a U.S. scientific research organization.

Investigation on Formation of 2223 Phase in Bi-System Superconductor Containing Pb

40100076A Beijing DIWEN WULI XUEBAO [CHINESE JOURNAL OF LOW TEMPERATURE PHYSICS] in Chinese Vol 14 No 4, Jul 92 pp 259-267

[English abstract of article by Che Guangcan, Jia Shunlian, et al. of the Institute of Physics, CAS, National Lab. for Superconductivity, Beijing 100080; MS received 19 Nov 91]

[Text] The volatilization of components, composition, sintering temperature and time, T_c and the formation of 2223 phase for Bi-system superconductor have been investigated by means of X-ray diffraction, DTA, superconductivity measurements and electron microscope. The results show that when sintering temperature < 910°C, component volatilization has not been observed except component Pb. The optimum starting material composition is $Bi_{1.70}Pb_{0.30}Sr_2Ca_2\ Cu_3O_x$, starting temperature at 830-845°C and sintering time > 72 hours for preparing superconductor of high 2223 content. Bulk superconductors with T_c near 110K, excellent homogeneity and 2223 phase content > 90% have been prepared.

Effect of Heat Treatment Conditions on T_c and Phase Structure of 110K Superconductor in BiPbSrCaCuO System

40100076B Beijing DIWEN WULI XUEBAO [CHINESE JOURNAL OF LOW TEMPERATURE PHYSICS] in Chinese Vol 14 No 4, Jul 92 pp 283-288

[English abstract of article by Yang Beifang, Deng Hua, Wang Xiaoyang, Cai Weili, and Ruan Yaozhong of the Department of Materials Science and Engineering, USTC, Hefei 230026, Zeng Xinlin of the Department of Physics, USTC, Hefei 230026, Jia Shunlian and Huang Yunlan of the Structure Research Lab., USTC, Hefei 230026; MS received 19 Nov 91]

[Text] High-quality single-phase polycrystalline sample of 110K superconductor $Bi_{1.92}Pb_{0.37}Sr_2Ca_2Cu_{3.03}O_y$ was prepared by solid state reaction, the temperature of zero resistance of which is 107K. In this paper, the effects of the sintering temperature and post-sintering cooling rate on T_c and single-phase quality are investigated. The results show that the single-phase degree of the samples depends mainly on the sintering temperature and slow cooling favors the raising of T_c.

Single-Mode 565 Mbps Digital Optical Transmitter Developed

92P60424A Chengdu DIANZI KEJI DAXUE XUEBAO [JOURNAL OF UNIVERSITY OF ELECTRONIC SCIENCE AND TECHNOLOGY (UEST) OF CHINA] in Chinese Vol 21 No 3, Jun 92 p 292

[Article by UEST researchers Qiu Qi [6726 3825], Mei Kejun [2734 0344 0193], and Chen Sizhen [7115 1835 3791]: "Single-Mode 565 Mb/s High-Speed Digital Optical Transmitter"]

[Summary] The authors have developed a single-mode 565 Mbps [i.e., DS5] digital optical transmitter, a key component in DS5 fiber optic communications systems. This modularized product has the following main performance indicators: transmission rate is 565 Mbps with NRZ [non-return-to-zero] code (or 622 Mbps, NRZ code), interface voltage level is at the ECL [emitter-coupled logic] standard level, system employs single-mode fiber and 1.3-µm-wavelength single-mode semiconductor lasers, transmitting optical power (average power out of the fiber) exceeds -3 dBm [-3 decibels referenced to a milliwatt] and has a maximum value of -0.79 dBm, extinction ratio is less than 0.05, and output optical power stability is better than +/-5 percent. These performance parameters match those of foreign-made products of comparable kind as of the mid-eighties.

Corporate Executive Looks at China's Telephone Industry

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[Article by Xie Xiaoan [6043 2556 1344], Chairman of the Board, Beijing International Switching Systems Corporation: "Support the Telephone Industry To Satisfy Communications Needs"]

[Text] Since the advent of reform and opening to the outside world, China has added to its existing telephone industry with the building and development of a number of high technology telephone industry factories and associated electronics parts industries. China has established joint venture plants with Belgium, Germany and Japan for the production of high-capacity SPC [stored program controlled] digital telephone switching equipment. In addition, it has two production lines that were researched and developed in China. These plants form the foundation for China's telephone industry. Manpower, financial, and materials resources must be concentrated, leadership must be focused, and overall planning must be done to provide careful support for them.

Speed of Development of China's Telephone Communications Since Reform and Opening to the Outside World, and a Forecast For the Future

China's telephone communications have developed by leaps and bounds in recent years. In the wake of Comrade [Deng] Xiaoping's remarks during his travels in south China, in particular, the posts and telecommunications sector has made further readjustments and improvements to reach the development goals set forth in the Eighth and Ninth 5-year plans. Calculated in terms of the total number of main line telephones nationwide (including the total number of urban telephone, rural telephone, and PBX mainline number users), the total numbers of main-line telephone instruments in use in 1985 and 1990, as well as those planned for 1995 and 2000, are (respectively) 1.5 times, 3.1 times, 7.4 times, and 15.5 times the number in use in 1980, or eight times the number in the original plan (meaning there will be eight times as many in 2000 as in 1980). This is nearly a doubling every 5 years. At the same time, the total capacity of the nation's telephone switching equipment will be 1.5, 3.0, 7.2, and 14.4 times the 1980 capacity. Since the 1950's, the number of telephones in the world has generally doubled once every decade, but in China, the number tripled between 1970 and 1980, and increased 400 percent between 1980 and 1990. Clearly, China's telephone industry has developed at very high speed.

Inasmuch as the foundation for China's telephone communications is still very weak, despite the increased speed of development, the absolute number of telephones during each period of development remained relatively low. One important indicator in judging a country's communications is the rate of telephone spread, meaning the number of main line telephones per 100 people in the country's whole population. In 1980, this figure was 0.43 for China, and in 1985 it was 0.65; in 1990 it will be 1.14, and in 1995 and 2000, it will be 2.55 and 5.02 respectively. In 1990, there were 520 million main line customer telephones in the world, and the telephone spread rate averaged 9.85. This is to say that by 2000, China's telephone spread rate will still lag far behind today's world average. We must confront this problem head-on in order to meet communications needs during the great communications development age. The Eighth 5-Year Plan and the Ninth 5-Year Plan periods are crucial to the laying of a foundation for a take-off in the development of China's communications during the 21st century. We must pay close attention and devote constant attention during this period, not permitting the slightest mistake so that the development of China's communications will enter a new era of a completely benign cycle by the end of the present century.

Telephone Exchange Switching Equipment Needs For the Development of Telephone Communications During the Eighth and Ninth 5-Year Plans

Only by extrapolating the amount of output China requires on the basis of the foregoing situation will it be possible to meet and satisfy the steadily developing requirements of the country's telephone communications market during the Eighth and Ninth 5-year plans.

Total telephone exchange capacity (including total capacity of urban telephones, rural telephones, and PBX equipment) was 20 million lines in 1990. It 1995 and 2000, it will be a projected 48 million and 96 million lines. Clearly, capacity will have to be increased by 28 million lines during the Eighth 5-Year Plan, or an average annual 5.6 million lines. During the Eighth 5-Year Plan, capacity will have to be increased by 48 million lines or an average 9.6 million lines per year. This includes a telephone

exchange switching capacity (i.e., the equipment capacity for urban telephones and rural telephones added together) of 12.5 million lines in 1990, and a projected 34 million and 70 million lines in 1995 and 2000 respectively. Therefore, during the Eighth 5-Year Plan, capacity will have to be increased by 21.5 million lines, or an average 4.3 million lines per year. During the Ninth 5-Year Plan, capacity will have to be increased by 36 million lines, or an average 7.2 million lines per year.

Estimate of Supply and Demand for Telephone Exchange Public Telephone Network Switching Equipment in China During the Eighth and Ninth 5-Year Plans

At the present time, China has three joint venture corporations producing the high-capacity SPC digital telephone switching equipment that telephone exchanges need. Shanghai Bell Corporation (SBTEMC) produces the S1240; Beijing International Switching Systems Corporation (BISC) produces the EWSD, and Tianjin-NEC (TJNEC) produces the NEAX61. In addition, the first and tenth research institutes of the Ministry of Posts and Telecommunications (MPT) Scientific Research Academy have jointly researched and developed a domestically made production line, and the Zhengzhou Information Engineering Academy has cooperated with the MPT Industrial Corporation on the research and development of another domestically made production line. During the Eighth 5-Year Plan, the total output of these three joint venture corporations is expected to reach 15.5 million lines. This includes an output of 10 million lines from Shanghai Bell between 1991 and 1995; an output of 3 million lines from Beijing International between 1992 and 1995, and an output of 2.5 million lines from Tianjin-NEC between 1993 and 1995. The requirement is for 21.5 million lines, the 6 million line shortfall to be made up by other domestic factories and through foreign credits. Thus, one might say that supply and demand are largely in balance during the Eighth 5-Year Plan.

During the Ninth 5-Year Plan, the gross output of these three joint public-private corporations for the period 1996 through 2000 is expected to reach 40 million lines, or an average 8 million lines each year. This includes 18 million lines by Shanghai Bell, or 3.6 million lines each year; 11 million lines from Beijing International, or 2.2 million lines each year; and 11 million lines from Tianjin-NEC, or 2.2 million lines each year. The requirement is for 36 million lines, meaning a surplus output of 4 million lines. Thus, one might say that China's production plans are entirely capable of satisfying the country's needs for switching equipment used in telephone exchanges for the building of its public telephone network during the Ninth 5-Year Plan. It also has a substantial surplus that may be used to supply the country's specialized telephone networks, as well as the needs of some foreign customers.

Concentration of Energies to Support the Country's Existing Telephone Industry So As To Prevent a Second Round of "International Brands"

At the present time, eight manufacturers in seven countries make the high-capacity SPC digital telephone switching equipment used in China's public telephone network. This might be called an international brand system that includes virtually every model in the world. The equipment consists of FETEX 150's from Japan's Fujitsu Corporation, NEAX 61's from NEC, S1240's from Belgium Bell Telephone Equipment Corporation, EWSD's from Siemens Corporation in Germany, AXE10's from Sweden's L.M. Ericsson, NO.5ESS's from American Telephone and Telegraph, E10B's from France's Alcatel Corporation, and DMS's from Canada's Northern Telecom. It also includes the S1240's, EWSD's and NEAX61's that are produced in the three joint venture corporations in China. In a general sense, these models of telephone switching equipment have become international favorites. They have played a fine role and made a major contribution in the building of China's telephone communications. Nevertheless, too many models of equipment are bound to have unfavorable consequences for a country's communications network in terms of manpower, financial resources, and construction speed, as well as in management. Thus, the countries of the world, particularly developed countries, usually select one model of equipment or two or three models at most. China has had some profound lessons of experience in this regard. During the mid-1980's, quite a few experts made a case for "guarding against international brands." At that time, however, a mistaken—or an least an inaccurate—idea developed. It was generally believed that the demand for equipment was greater than the supply. This gave rise to the false notion that only by importing production lines for another two or three different models of equipment could demand be satisfied.

In this connection, I would like to present some data for consideration in comparing two different plans for attaining the goal of increasing output to 1 million lines. Plan A provides for the construction of a joint-venture factory to produce 1 million line of new model equipment. Plan B calls for expansion of production to 2 million lines per year of a joint venture plant that is currently producing 1 million lines per year. (See table below). Comparison of the data shows clearly that the building of a joint venture plant for new-model equipment, versus expansion of the existing plant (not necessarily at the existing plant site), not only increases by one the number of models of Chinese manufactured equipment, but also wastes an extremely large amount of manpower, financial and material resources, as well as time. What reason do we have for importing production lines for more equipment models? Are the current five different equipment models too few?

Plan	Investment	Personnel	Construction Time	Technology Transfer Expenses	Technical Assistance Expenses	Investment in Chinese Manufacture	Training Force
A. Investment in New Joint-Venture Plants	100	100	100	100	100	100	100
B. Investment in Expansion of Joint-Venture Plants	50	70	30	10	10	10	20

Furthermore, given the country's circumstances, a high-capacity SPC digital telephone switching equipment production plant having an annual output of between 300,000 and 500,000 lines meets the break-even point. When output reaches 1 million lines per year, it begins to enter the optimum economic returns zone. This is to say that because of mass production, the cost per line begin to decline, and the sale price and the profit per line also begins to decline, but returns per unit of investment gradually rise. An example is the Shanghai Bell Corporation, which produced 200,000 lines annual during the initial period following plant construction. The sale price per line was very high, and the plant encountered very great marketing difficulties. Thanks to vigorous state support and the efforts of all personnel, output during 1992 surpassed 1 million lines. Now this corporation has the lowest product prices in the business domestically, and its economic returns are the highest.

The 1990's will be a period of great readjustment, major reorganization, and great changes in the world's economic pattern. In the telephone switching equipment production field, the international trend is toward competition on miniaturization and multiple functions. It is expected that, in general, only half of competing equipment models will survive into the 21st Century. Internationally, "international brands" are gradually disappearing, and it seems that we must also not develop a second "international brands" in our telephone industry. It is to be hoped that, while traveling the road of reform and opening to the outside world, we will be able to concentrate the country's limited manpower, financial, and material resources, and make use of valuable time to centralize leadership, do overall planning, and make a cooperative division of labor to provide vigorous support to the nation's telephone industry.